



# ESCoP 2017

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# Keynote Lectures

## Keynote Lecture I

Sunday, 17:15 – 18:15, Room: HS3-4

FRIEDEMANN PULVERMÜLLER

*Freie Universität Berlin, Germany*



### **Cognitive and Brain Mechanism for Concepts and Meaning: A Review of the Grounding / Embodiment Debate**

Classic amodal symbol theories conceive concepts and meanings as abstract mental entities without intrinsic relationship to information about concrete aspects of objects and actions. The modular amodal semantic system housing these entities is assumed to sit in multimodal areas of cortex. Searle and Harnad criticised this framework arguing that meaning cannot be intrinsic to a symbolic system because one cannot learn Chinese from a Chinese dictionary alone. What symbols are used to speak about, their reference, plays an eminent role for semantics. Therefore, grounded theories see intrinsic semantic links between symbolic and object-/action-related representations, with the latter providing crucial information about conceptual structure. Behavioural and brain imaging experiments indicate that, in specific semantic and even passive tasks, referential semantic information about symbols draws upon modality-specific information, thus bolstering semantic grounding.

However, these findings and their interpretation in favour of the semantic grounding framework have led to critical questions and discussion: 1. Would grounding effects replicate across studies? 2. Can they be explained by cognitive processes irrelevant to semantic understanding? 3. How would a neuromechanistic approach explain variability of results across tasks and contexts? 4. Would relevant areas that light up in a specific condition be also relevant functionally, and would sensory and motor dysfunction come with semantic and conceptual deficits? 5. How can a rich repertoire of semantic properties be integrated with sensory or motor features? Crucially, why should there be both modality-general and modality-specific mechanisms in semantic processing; and what could their respective contributions be? And finally: How would concepts like "love" and "fear", for which some machinery seems built into our brains, be linked to their symbolic correlates, and be influenced by interactive learning? After reviewing the state-of-the-art of the so-called grounding or embodiment debate, I will propose some solutions of these puzzles based on a neurobiological model of language and concepts, which has recently been spelt out in detailed neurocomputational simulation studies.

**Broadbent Lecture**

Monday, 18:30 – 19:30, Room: HS3-4

BEATRICE DE GELDER

*Maastricht University, The Netherlands*



**The Power of Images:  
Sensory Systems, Real Emotions, Virtual Bodies**

Human emotion research has traditionally been largely restricted to experiments using facial expressions. In the past decade we have seen a long overdue extension of this narrow focus. Various groups have investigated whole body expressions and have also placed the face back in its natural context, as part of the body. In this talk I will review past research, highlight themes that have emerged in our research of the past decade and sketch some imperatives for future directions including the novel methodological and theoretical innovations that are now within reach by scaling up current virtual and augmented reality techniques.

**Bertelson Lecture**

Wednesday, 18:30 – 19:30, Room: HS3-4

MICHAEL BANISSY

*Goldsmiths University London, United Kingdom*

**Sharing the States of Others: Understanding Factors Contributing to Individual Differences in Vicarious Experience**

Our capacity to share the experiences of others is a critical part of social behaviour. One process thought to be important for this is vicarious perception – the ability to co-represent the experiences of other people by matching the observed state onto representations of our own first-hand experience. For example, observing pain in other people activates some of the same network of brain regions as the first-hand experience of pain. For most of us vicarious perception is implicit (i.e. unconscious), but for some individuals viewing another person's state results in them literally experiencing a conscious sensation of the observed event. In this talk I will discuss a series of studies examining the prevalence, characteristics and mechanisms that contribute to conscious vicarious perception. I will discuss work that we have conducted on mirror-touch and mirror-pain synaesthesia: rare experiences where seeing somebody else being touched or in pain evokes first-hand sensations on the observer's own body. I will argue that conscious vicarious perception in mirror-touch / mirror-pain synaesthesia is related to disturbances in the ability to distinguish the self from others, and consider the implications of this for our understanding of the role that mechanisms of self-other representation play in our ability to understand the experiences of others.

# Abstracts

## Perception

### H1, Monday, 09:00 – 10:40

.. 09:00 – 09:20 (1) ..

**Bottom-up and top-down processing in preference for curvature.** ENRIC MUNAR, GUIDO CORRADI, JAUME ROSSELLÓ & JAVIER VAÑÓ; *University of the Balearic Islands, Spain*

Preference for visual curvature is a well-established effect. Munar et al (2014) found differences in the effect between long and short presentation time. These differences have not been studied in a systematic way. A useful approach to study visual preferences is microgenetic perspective, which has been used in different fields. Our first experiment is aimed at getting to know more about the time course of preference for curvature with real objects. Here, we used the same paired comparison task than in Munar et al (2014). On the other hand, curvature is considered a mid-level representation in the hierarchical perspective of the visual system (Groen, Silson & Baker, 2017). Furthermore, high-level vision implements abstraction of the visual input into semantic representations that enable easy classification or identification of the object. Thus, the content of the images of real objects could have influenced preference as well. As other researchers, we assume an interaction of bottom-up and top-down phenomena in terms of a time course contingency. The second experiment was designed to prevent, as far as possible, the influence of semantic content on preference for curvature using meaningless stimuli (Bertamini et al, 2015). The results of the experiment 1 show that 80 milliseconds presentation time is a peak in preference with real objects. The results of experiment 2 reveal that preference for curvature with meaningless patterns increases as the time presentation increases. Our conclusion is that the effect is maintained, even increased, as long as there is minimal interference from the meaning content.

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.. 09:20 – 09:40 (2) ..

**What's good about big pupils?** SEBASTIAAN MATHÓT & YAVOR IVANOV; *University of Groningen, Netherlands, The*

The pupil light response is believed to reflect a trade-off between visual acuity (small pupils see sharper) and sensitivity (large pupils are better able to see faint stimuli); that is, pupils take on the smallest size that still allows sufficient light to enter the eye. But why then do pupils dilate when we get

aroused, apparently perturbing this delicate trade-off? We hypothesized that the optimal pupil size depends on the situation; specifically, we hypothesized that small pupils are best for calm, focused behavior, whereas large pupils are best for vigilance. To test this, we asked participants to perform one of two tasks: discrimination of a fine tilted grating in central vision (a model of calm, focused behavior); or detection of a faint stimulus in peripheral vision (a model of vigilance). We manipulated pupil size by varying ambient luminance, while keeping the luminance of the task-relevant stimuli constant. We found that discrimination performance did not systematically depend on pupil size; however, detection performance was much better when pupils were large. This suggests that pupil dilation in response to arousal is not, as is often suggested, a nonfunctional epiphenomenon; rather, it optimizes vision for vigilance.

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.. 09:40 – 10:00 (3) ..

**Order Effects in Comparative Judgments and their Implications for Models of Stimulus Discrimination.** RUBEN ELLINGHAUS, KARIN M. BAUSENHART & ROLF ULRICH; *Tübingen University, Germany*

In psychophysical experiments which investigate the human ability to discriminate sensory stimuli, participants are typically instructed to compare the magnitude (e.g. level of loudness, brightness etc.) of a variable comparison against the magnitude of a constant standard. Many prominent models of stimulus discrimination assume that participants compare the magnitudes of their internal representations of these two stimuli. Consequently discrimination performance should depend on the physical magnitude difference but not on the presentation order of standard and comparison. However, in duration discrimination experiments discrimination sensitivity is usually higher when the comparison follows rather than precedes the standard, a result referred to as Type B order effect. We demonstrate that this effect is not restricted to the domain of temporal cognition, but rather a general discrimination phenomenon emerging also across a range of other stimulus attributes such as frequency, intensity, and numerosity in both vision and hearing. Accordingly, models of stimulus discrimination should consider this effect in order to enable a comprehensive account of human stimulus discrimination. For example, the Internal Reference Model (IRM) predicts a Type B order effect as a result of a continuously updated internal stand-

ard which is used as a referent in the comparison process.

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.. 10:00 – 10:20 (4) ..

**Attentional requirements in perceptual grouping depend on the processes involved in the organization.** EINAT RASHAL<sup>1,2</sup>, YAFFA YESHURUN<sup>2</sup> & RUTH KIMCHI<sup>2</sup>; <sup>1</sup>EPFL, Switzerland; <sup>2</sup>University of Haifa, Israel

Previous studies on the role of attention in perceptual grouping have yielded contradicting findings, some suggesting that grouping requires attention, whereas others indicating that it does not. Kimchi and Razpurker-apfeld (2004) showed that attentional demands in grouping could vary according to the processes involved. The current study expanded on this, examining whether attentional demands vary for (a) different grouping principles, and (b) as a function of contingent processing of element segregation and shape formation. We used the inattention paradigm with an online measure, in which participants engaged in an attentionally demanding change detection task on a small matrix presented on a task-irrelevant backdrop of grouped elements. The backdrop grouping changed or stayed the same independently of any change in the target. Congruency effects produced by changes in backdrop grouping on target-change judgments indicate that the backdrop grouping was accomplished under inattention. The results showed congruency effects when grouping formed columns/rows by proximity but not by shape similarity, and when grouping into a distinct shape by collinearity did not involve element segregation. No congruency effects were found when grouping into a shape by collinearity or connectedness involved element segregation, except when connectedness was combined with color similarity. These results suggest that attentional demands depend on the combination of grouping principles and the complexity of the processes involved in the organization. These findings provide further support for the view that perceptual organization is a multiplicity of processes that vary in attentional demands.

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.. 10:20 – 10:40 (5) ..

**Tactile stimulation disambiguates the perception of visual motion paths.** HAUKE S. MEYERHOFF<sup>1</sup>, SIMON MERZ<sup>2</sup> & CHRISTIAN FRINGS<sup>2</sup>; <sup>1</sup>Leibniz-Institut für Wissensmedien, Germany; <sup>2</sup>University of Trier

The visual system continuously resolves ambiguity within the retinal information with respect to the shape as well as relative size and speed of objects by applying heuristics such as the Gestalt

principles. With more than one object moving in a dynamic scene, the correspondence between object locations over time also needs to be disambiguated.

Here, we study this phenomenon using displays in which two discs move toward each other, superimpose in the center of the screen, and then moved apart. This display is perceptually ambiguous because it is consistent with the interpretation of two disc streaming past each other as well as the interpretation of two discs bouncing off each other. We show that the visual system incorporates coinciding tactile information in order to disambiguate the motion paths of the two objects by measuring explicit impressions (i.e., asking participants whether they perceive streaming or bouncing) as well as implicit perceptual processes (i.e. the perceived overlap between the moving discs). In the first of two experiments, we observed that the dominant interpretation of the motion paths switched from streaming to bouncing when a brief vibrotactile stimulation (applied to the left hand of the participants) coincided with the moment of overlap between the moving discs. In the second experiment, the participants adjusted the overlap between two additional static discs until it matched with the perceived overlap of the ongoing bouncing/streaming event. The results of this experiment showed that coinciding tactile stimulation also reduced the perceived overlap between the two moving discs thus leaving a larger uncovered illusory crescent. In return, this larger crescent might induce the impression of bouncing rather than streaming. Our results therefore suggest that the tactile information indeed altered the visual percept of the dynamic event rather than the subsequent cognitive interpretation of an otherwise unaffected visual percept.

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## Attention H2, Monday, 09:00 – 10:40

.. 09:00 – 09:20 (6) ..

**Is the attentional spotlight asymmetrical?** NICOLE A THOMAS & MICHAEL E R NICHOLLS; *Flinders University, Australia*

Cognitive load influences distractibility; distractors are more likely to be processed and decrease reaction times during low load. Attentional resources are more limited during high load, limiting our ability to process peripheral stimuli. Therefore, reaction times are quicker in the presence of distractors during high cognitive load. We manipulated distractor location to determine whether



location differentially influenced the degree of distractibility. Participants completed an irrelevant-distractor paradigm. On 80% of trials participants identified whether the target was 'X' or 'N'. During low load, non-target stimuli consisted of lower case 'o' letters, whereas during high load, heterogeneous angular letters, with the same dimensions as the target were used. In the remaining 20% of trials, a cartoon character appeared in the periphery (above, below, left or right of the visual search array). Reaction times were recorded on each trial. There was a strong effect of cognitive load, as RTs were faster during low load than high load. Importantly, the interaction of cognitive load and distractor location was significant. During low load, reaction times increased equally for all distractor locations. In contrast, left distractors speeded reaction times significantly more than did right distractors during high load. We suggest that the attentional spotlight was sufficiently large to encapsulate both the distractor and the visual array during low cognitive load, leading to increased distraction, whereas the attentional spotlight split across the two visual stimuli during high load. Further, executive control is better in the left visual field, which prevents distraction and provides a greater performance benefit.

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.. 09:20 – 09:40 (7) ..

**Effect of Gaming on Desktop 360-degree Field of View Interaction.** PRIYANKA SRIVASTAVA, ANIRUDDH RAVIPATI & AMBIKA SAHU; *International Institute of Information Technology, Hyderabad, India*

Despite growing importance of the 360-degree field of view (FOV), very few studies have evaluated the individual differences, such as gaming experience, in such interactions. Further, the studies lack the evaluation of time-induced stress during such interactions. An eye-tracking experiment was conducted to assess the effect of gaming under timer vs. no-timer condition, on the navigation, direction estimation, and spatial memory while using various 2D 360-degree interface designs.

Participants' tasks were to navigate the 3D terrain, locate the targets with perceived egocentric direction, and later place the targets on the overhead map of the terrain. Interfaces, gaming, and timer were compared based on navigation time, egocentric direction judgment and target placement accuracy.

Behavioral results showed an advantage of gaming in navigation and in direction estimation. Though non-timer favored the gamers in direction estimation, the timer condition did not show any gain of gaming experience. Interfaces with visual boundaries showed an advantage in direction es-

timination. However, no effect of interface design and gaming experience was observed on target placement task, indicating no map development during the exploration phase.

Eye-tracking data on direction judgment task showed no advantage of gaming for fixation count, fixation duration and latency to the first fixation across the displays with visual boundaries, demonstrating no difference in exploration strategy. However, the advantage of gaming in direction estimation suggests the effect of learning from their first person shooter (FPS) gaming platform. Further, gamers showed a difference in exploration strategy in the seamless display design. In this, gamers took a longer time to the first fixation across the FOVs. Further, they showed the least fixation duration to rear vs. front FOV.

The results suggest for considering the individual differences for future effective interactions by showing a difference in exploration and estimation task as per 360-degree display designs and gaming experience.

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.. 09:40 – 10:00 (8) ..

**Multiple object tracking affects pointing movements precision.** PIOTR STYRKOWIEC & ANNA CHRZANOWSKA; *University of Wroclaw, Poland*

Multiple object tracking (MOT) requires visual attending to dynamically moving targets and distractors. This cognitive ability is based on perceptual-attentional processes that are also involved in goal directed movements. This study aimed thus to test hypothesis if MOT affects motor performance of aiming movements. To this end participants performed pointing movements, with the use of their fingers or with the cursor controlled with movements of computer mouse, to the targets from MOT task. As precision of pointing movements was measured, it was predicted that higher number of targets and distractors in MOT will lead to lower precision of pointing. The results confirmed this hypothesis indicating that MOT might influence motor actions performance. Potential factors underlying this influence are discussed.

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.. 10:00 – 10:20 (9) ..

**Flexibly shifting the attentional focus to external objects versus memory representations.** PATRICK H. KHADER<sup>1</sup>, SARAH GLIM<sup>2</sup> & JASMIN M. KIZILIRMAK<sup>3</sup>; <sup>1</sup>Brandenburg Medical School, Germany; <sup>2</sup>Technical University Munich; <sup>3</sup>University of Hildesheim

Attentional selection has been investigated in perception (selective attention) and memory (selective retrieval). However, it is unclear whether

selection in both domains share a common cognitive and neural basis and only differ in the stimuli they act upon (external sensory environment or internal memory space), or whether each domain has its own specific selection process. To examine whether similar attentional processes underlie the dynamic selection of sensory and mnemonic stimuli, we developed a paradigm that tried to match the demands on cognitive control processes in memory vs. perception. To this end, we employed a within-subjects task with similar stimulus material and a similar attentional selection procedure. Behavioral costs and benefits were compared across trials in a visual perception task and a task of long-term memory (LTM) retrieval. In both tasks, participants had to selectively respond to one stimulus from a predefined set of potentially response-relevant stimuli. From trial to trial, we systematically varied whether the composition of this set or the to-be-selected stimulus within the set was repeated or changed. Results of both tasks revealed faster reaction times when the set was repeated and when the stimulus was repeated compared to when it changed. Despite these commonalities that speak for a general correspondence of flexible attentional switching during visual perception and LTM retrieval, there were also remarkable differences between the attentional domains. Specifically, when an item presented as a target in the current trial had to be ignored in the previous trial, behavioral costs emerged in the visual perception task (i.e., negative priming), but behavioral benefits emerged in a corresponding condition of the LTM task (i.e., positive priming). We therefore conclude that different, but overlapping inter-trial priming mechanisms might underlie differences in the flexible switching of attention in internal vs. external representational space.

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.. 10:20 – 10:40 (10) ..

**Attention during goal engagement and goal disengagement.** CLARA HELLWEG & CHRISTINA BERMEITINGER; *Universität Hildesheim, Germany*

When we try to reach a goal there may be obstacles that impede us from achieving the goal. In this case there are two possible reactions: You can either hold on to the goal and still try to reach it (goal engagement) or you can let go of the goal and turn towards new achievable goals (goal disengagement). These two reactions are accompanied by different cognitive processes, e.g. differences in the attentional focus. The present study investigated attentional differences during goal engagement and disengagement. Participants worked through tasks from the German version of the Compound Remote Associate (CRA) Test while simultaneously performing a cognitive paradigm to

measure attention. In order to experimentally create a blocked goal, similar tasks to those of the CRA Test were added, which were unsolvable. The results suggest that goal engagement and disengagement are accompanied by differences in attentional focus.

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## Working Memory I H5, Monday, 09:00 – 10:40

.. 09:00 – 09:20 (11) ..

**The contribution of trial-by-trial fluctuations to age-related differences in working memory.** KERSTIN JOST<sup>1,2</sup>, ATSUSHI KIKUMOTO<sup>3</sup>, TINA SCHWARZKOPP<sup>2</sup> & ULRICH MAYR<sup>3</sup>; <sup>1</sup>Brandenburg Medical School, Germany; <sup>2</sup>RWTH Aachen University; <sup>3</sup>University of Oregon

In working memory (WM) tasks, older adults often perform worse than younger adults. Reduced WM capacity might be the main reason for these age effects. However, there is growing evidence that variations in attentional control may also play a role. For individual differences in WM performance, the consistency of attentional control turned out to be a relevant predictor. The important question that arises from this finding is whether trial-by-trial fluctuations in WM performance do also contribute to the overall smaller capacity estimates in older adults. To investigate this, we measured visual WM by means of a whole-report procedure that allows tracking the allocation of WM resources in each trial. More precisely, we examined the distributions of the number of correctly recalled items in 25 young and 25 older adults. In accordance with previous findings, younger adults differed in their consistency of WM performance: Individuals, who scored low in a standard WM task (low-capacity individuals), showed more performance failures than high-capacity individuals even though they performed equally well in a large proportion of trials. Thus, fluctuations in attentional control seems to be a major factor for individual differences in WM performance rather than the storage capacity per se. In contrast, for the elderly at least some individuals exhibited a performance pattern that better fits with a capacity decline going beyond mere attentional failures. Thus, our findings suggest that both variations in the consistency of attentional control as well as variations in WM capacity contribute to individual differences in WM performance of older adults.

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.. 09:20 – 09:40 (12) ..

**Working memory for self-initiated and provided spatial sequences.** HAGIT MAGEN<sup>1</sup> & TATIANA-ALOI EMMANOUIL<sup>2</sup>; <sup>1</sup>*Hebrew University of Jerusalem, Israel*; <sup>2</sup>*Baruch College and the Graduate Center of the City University of New York, New York, USA*

In their daily life people often use working memory (WM) to hold external information provided to them, for short durations. However, in many other occasions people memorize information they actively choose themselves. While prevalent in everyday behavior, this aspect of WM, we term self-initiated WM, has not been investigated. The present study used a modified spatial span task, in which participants constructed the spatial sequences they maintained in memory. The results of three experiments demonstrated that when asked to construct their own sequences, participants planned and constructed structured spatial sequences, by minimizing the distances between successive locations, and by selecting sequences with fewer path crossings. Furthermore, participants tended to initiate the spatial sequences on the top left side. Memory accuracy was enhanced when participants memorized self-initiated spatial sequences relative to maintaining provided sequences, even when the provided sequences were matched for structure. When asked to construct spatial sequences for a hypothetical competitor in a memory contest, participants constructed complex sequences with longer paths and more path crossings, suggesting that these sequence parameters were under their control. The tendency to initiate the spatial sequences on the top left side remained even when participants constructed complex sequences. Taken together, the results suggest that self-initiated WM benefits from metacognitive knowledge of the ideal structure of memory representations, but the results also show superior memory for self-initiated spatial sequences that goes beyond the benefit of structure.

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.. 09:40 – 10:00 (13) ..

**Transfer effects of two working memory updating training programmes.** ROCIO LINARES<sup>1</sup>, ERIKA BORELLA<sup>2</sup>, M. TERESA LECHUGA<sup>1</sup>, BARBARA CARRETTI<sup>2</sup> & SANTIAGO PELEGRINA<sup>1</sup>; <sup>1</sup>*University of Jaén, Spain*; <sup>2</sup>*University of Padova, Italy*

#### Background

There is some controversy about the possibility to obtain near and far transfer effects after WM training programmes and the mechanisms underlying the induced gains, when found. In the present study, we aimed to analyze the mechanisms involved in transfer effects of two WM updating training programmes in young adults (mean age= 21.3 years).

#### Method

To these aims, we studied the transfer effects induced by two working memory updating (WMU) training programmes based on two different updating tasks: a n-back task and arithmetical updating task that were administered over six sessions. Nearest transfer effects were assessed with a set of WMU tasks that were more or less structurally similar to the trained ones. Near and far transfer effects were tested with different working memory and fluid intelligence tasks. Participants' performance in these two WMU training programmes was compared with outcomes of a control group that engaged in videogames that did not tap WMU.

#### Results

Results showed that WMU training induced improvements only in those WMU tasks structurally similar to the trained ones. No benefits were found either in the WMU tasks that did not share structure with the trained tasks, or in working memory and fluid intelligence tasks.

#### Discussion

The limited transfer effects to tasks structurally similar to the trained ones suggest that the gains were due to a strategy acquisition rather than to an improvement in the updating process.

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.. 10:00 – 10:20 (14) ..

**Semantically unexpected auditory distractor words produce larger disruption.** JAN PHILIPP RÖER, RAOUL BELL, ULRIKE KÖRNER & AXEL BUCHNER; *Heinrich Heine University Düsseldorf, Germany*

It is an open empirical question to which extent task-irrelevant, to-be-ignored speech is processed semantically. In the present series of experiments, we compared the disruption of serial recall by two categories of distractor sentences, (1) sentences with semantically expected endings and (2) sentences with semantically unexpected endings. Opposing predictions can be derived from theories of memory and attention as to the amount of disruption these sentences should produce. According to an automatic account of interference, the disruptive effect of irrelevant speech is only determined by acoustic and not semantic features. According to a functional view of auditory distraction, irrelevant speech is routinely processed semantically in order to determine its relevance for the individual. Sentences with semantically unexpected endings produced a larger amount of disruption than sentences with semantically expected endings. This pattern of results suggests that semantic features of irrelevant speech are processed, and that this processing may disrupt the maintenance of information in short-term memory.

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.. 10:20 – 10:40 (15) ..

**Is working memory involved in monitoring self and other people's speech?** JOHN RICHARD HANLEY<sup>1</sup> & NAZBANOU NOZARI<sup>2</sup>; <sup>1</sup>*University of Essex, United Kingdom*; <sup>2</sup>*Johns Hopkins University, USA*

Background.

Neuropsychological, electrophysiological and neuroimaging data suggest distinct primary mechanisms for self- and others'-speech monitoring. However, there is also evidence that the processes involved in these two monitoring conditions may overlap. This study investigated whether working memory with or without inhibitory control is part of the shared mechanisms between self- and others'-speech monitoring.

Method.

Forty-two children aged between six and eleven years were asked to describe simple visual events involving nine highly familiar animals, and to repair any speech errors that they might detect (self-monitoring). They were also asked to listen to another child describing similar events and press a button when they detected an error (others'-detection) and correct the error (others'-correction). Children were also tested on working memory (forward digit span), and working memory + inhibitory control (backward digit span).

Results.

Measures of others'-detection and others'-correction were highly correlated, and both were moderately correlated with self-monitoring, pointing to some shared mechanisms in monitoring self- and others'-speech. However, while both forward and backward digit spans were reliably correlated with measures of monitoring other people's speech, they were not predictive of self-monitoring. In fact, there was a statistically-significant dissociation between the predictive effect of forward digit span on self-monitoring and others'-detection, a similar dissociation between the predictive effect of backward digit span on self-monitoring and others'-correction.

Discussion.

The findings support partially-overlapping monitoring mechanisms for self- and others'-speech. However, they suggest that working memory with or without inhibitory control has a much more prominent role in monitoring other people's speech than one's own speech.

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## Reading / Models H6, Monday, 09:00 – 10:40

.. 09:00 – 09:20 (16) ..

**Bridging the gap between models of single-word reading and text reading.** XENIA SCHMALZ<sup>1,2</sup>, ROBERT MAIER<sup>3</sup> & CLAUDIO MULATTI<sup>2</sup>; <sup>1</sup>*Ludwig-Maximilians-Universität München*; <sup>2</sup>*Università degli Studi di Padova*; <sup>3</sup>*Universität Augsburg*

The cognitive processes underlying reading are often studied in a Rapid Serial Visual Presentation (RSVP) paradigm, where participants are asked to read single words, presented without sentence context. Such experiments have led to detailed computational models and theories about visual word recognition. However, it is unclear what single word recognition processes are transferable to reading for meaning. According to the Dual Route Cascaded model of reading (Coltheart et al., 2001), visual word recognition occurs by three parallel cognitive processes: (1) the sublexical route: grapheme-to-phoneme decoding, (2) lexical-orthographic route: matching of a whole-word orthographic representation onto its phonological equivalent, and (3) lexical-semantic route: matching the whole-word orthographic representation to the word's meaning which, in turn, is linked to the phonological word form. There is evidence that the relative reliance on these processes is task-dependent (e.g., Cummine et al., 2011), therefore it is possible that experiments with the RSVP paradigm overestimate the importance of the sublexical and lexical-orthographic routes and underestimate the importance of the lexical-semantic route. In our experiment, German-speaking undergraduate students read a set of target words which were picked from the Potsdam Sentence Corpus (Kliegl et al., 2006), with decorrelated length and frequency. The words were presented to all participants in an RSVP paradigm, but half of the participants read them in meaningful sentences, while the other half read them in isolation, without sentence context. This allows for a direct comparison between single-word reading and reading for meaning, while removing cross-task differences such as response mode or simultaneous processing of adjacent words. When reading words in sentences, participants showed an effect of word predictability, suggesting that they processed semantics in the RSVP sentence reading task. The magnitude of the length and frequency effects were similar across tasks, suggesting that single-word reading experiments are also relevant for text reading.

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.. 09:20 – 09:40 (17) ..

**Morphological decomposition processes in single-word and sentence reading.**

BETTY MOUSIKOU & SASCHA SCHROEDER; *Reading Education and Development, Max Planck Institute for Human Development, Berlin, Germany*

**Background:** Research on morphological decomposition during early stages of reading has focused on single-word reading using the masked priming paradigm. Such research has yielded important findings, yet it is unclear whether the obtained results generalize to sentence reading.

**Method:** We investigated morphological processing of suffixed and prefixed German words in single-word reading using masked priming (Experiment 1), and in sentence reading using the fast priming paradigm in eye tracking (Experiment 2). In Experiment 1, target words (KIND) were preceded by five types of primes: (1) words comprising the target as a stem and an affix (kindlich); (2) nonwords comprising the target as a stem and an affix (kindhaft); (3) nonwords comprising the target as a stem and a non-affix (kindpern); (4) words comprising an unrelated stem and an affix (holzhaft); (5) nonwords comprising an unrelated stem and a non-affix (holzpern). In Experiment 2, target words (kindlich) were masked by random letter strings (luvktoxl) until the eyes crossed an invisible boundary located before the target word. At boundary crossing, the mask was replaced by a briefly presented prime (e.g., kindhaft or kindpern or holzhaft or holzpern) before the target appeared.

**Results:** We observed embedded stem activation for both suffixed and prefixed words in both experiments, independently of whether the prime contained an affix. The eye movement data further revealed that this effect was driven by the duration of the first fixation on the target and by differences in the probability to refixate it, thus indicating embedded stem processing during sentence reading.

**Discussion:** We discuss our findings within extant reading models of morphological processing and eye movement control.

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.. 09:40 – 10:00 (18) ..

**Modelling interactions between orthography and semantics in visual word recognition.**

WALTER J B VAN HEUVEN<sup>1</sup> & TON DIJKSTRA<sup>2</sup>; <sup>1</sup>*University of Nottingham, School of Psychology, United Kingdom*; <sup>2</sup>*Radboud University Nijmegen, Donders Institute for Brain, Cognition and Behaviour, the Netherlands*

Recent computational models of visual word recognition (e.g., Davis, 2010) have been successful in simulating orthographic effects in word recognition tasks. However, these models are limited to orthography and cannot simulate semantic effects in visual word recognition as well interactions

between orthography and semantics. Perea and Lupker (2003), for example, reported priming effects for semantically related primes (e.g., judge-COURT) and for transposition nonword primes created from semantically related words (e.g., jugde-COURT). We developed a new computational model that incorporates a flexible letter position coding scheme and a semantic level that makes it possible to simulate these priming effects. The letter position coding scheme of the model is based on the open-bigram model (Grainger & van Heuven, 2003) and the semantic layer is constructed using either free association norms or semantic spaces. Simulations revealed a high correlation between the pattern of form priming reported in Adelman et al. (2014) and the form priming effects generated by the model. Furthermore, the model accounted for a high percentage of the variance of the lexical decision latencies from the English Lexicon Project (Balota et al., 2004). These results as well as simulation results of semantic/associative priming effects reported in the literature will be presented.

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.. 10:00 – 10:20 (19) ..

**Eye-movement behavior during reading-while-listening.** HAYLEY WEIGELT-MAROM, YORAM ESHET & GAL BEN-YEHUDAH; *The Open University of Israel, Israel*

Today, many adult readers use text-to-speech technologies to support or accompany their reading. The Dual Coding theory (Paivio, 1990) suggests that visual information (text) complemented by auditory information of the text read aloud (narration of the text), results in better reading comprehension. Alternatively, the Cognitive Load theory (Sweller, 1998) claims that using both sensory channels simultaneously impairs the quality of information processing, which may result in inferior reading comprehension. Previous studies that tested the contribution of narration to reading comprehension assumed that reading (i.e., decoding processes) occurred while listening to the narration. Surprisingly, this assumption has not been tested empirically among adults. In the present study we used eye-tracking technology to examine (1) the effect of narration on eye-movements associated with reading, and (2) the influence of narration on reading comprehension relative to a condition without narration. The participants were 24 university students (Mage=25.76, SD=4.62), without learning disabilities. The participants read two expository texts, one with and one without narration, and their eye-movements were recorded. Following each text, participants answered 12 multiple-choice comprehension questions. Using an area of interest (AOI) analysis, we found differences in eye-movement behavior between the two condi-

tions. Reading speed was significantly higher in the without-narration condition compared to the with-narration condition, and variability in reading speed was larger in the former condition. In addition, compared to the with-narration condition, reading without-narration resulted in overall fewer fixations across AOIs and fewer regressions between AOIs (paragraph level). Despite these differences in reading behavior, comprehension scores were similar across conditions ( $M_{\text{with-narrator}} = 80$ ,  $SD = 12.09$ ,  $M_{\text{without-narrator}} = 80.55$ ,  $SD = 16.29$ ). Using the same experimental design, we are currently collecting data from students with reading disabilities. Results will be presented at the conference. Theoretical and pedagogical implications of these findings for the usefulness of text-to-speech interventions will be discussed.

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.. 10:20 – 10:40 (20) ..

**The Potsdam Comics Corpus (PoCoCo): A tool for the study of attentional and linguistic processing during multimodal reading.** JOCHEN LAUBROCK<sup>1</sup>, SVEN HOHENSTEIN<sup>1</sup>, EIKE RICHTER<sup>2</sup> & ANDRÉ KRÜGEL<sup>1</sup>; <sup>1</sup>Universität Potsdam, Germany; <sup>2</sup>Technische Universität Berlin, Germany

Reading and scene perception have largely been studied in isolation. However, in the real world these functions are often interrelated. For example, drivers need to interpret road signs or are distracted by billboard messages. Comics and graphic novels present an ideal testbed for how and when information from these separate channels is selected and processed. We present the Potsdam Comics Corpus (PoCoCo), an annotated corpus of eye movements collected from 100 readers during the reading of passages from graphic novels. Panels, main characters, and text are annotated by expert reviewers using GNML (Dunst, Hartel, Hohenstein, & Laubrock, 2016), a TEI-based XML dialect extending CBML. Results suggest a strong contribution of top-down mechanisms of attentional selection: Text, faces, characters, and salient objects capture attention, whereas large parts of even structured backgrounds are neglected. The amount of time spent on visual rather than textual elements correlates positively with comics expertise. Experiments using a gaze-contingent manipulation of panel or speech preview suggest that parts of the scene can be processed in peripheral vision, as elements can be selectively targeted from the previous panel when available. Finally, a formal description of the saliency of the scene in terms of the output of the neural network model DeepGaze-II (Kümmerer, Wallis, & Bethge, 2016) is available and is compared to the empirical eye movements. The model, which has been trained to predict real

and simulated eye movement on photographic images based on their description in terms of "deep features" from the VGG-19 neural network, generalizes well to comics drawings, and can explain a large fraction of readers' fixation location distributions. In perspective, PoCoCo will be enriched by data from a smaller number of readers reading passages from a larger number of graphic novels, allowing, e.g., for the investigation of differences between artistic styles.

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## Cognitive Neuroscience I H7, Monday, 09:00 – 10:40

.. 09:00 – 09:20 (21) ..

**Cognitive and Physical intervention on the aging brain : Would a combination of these two aspects lead to better cognitive enhancement ?** CLÉMENCE JOUBERT & HANNA CHAINAY; *Université Lyon 2 - Laboratoire d'Etude des Mécanismes Cognitifs, France*

Background : Normal aging is characterized by a normal age-related cognitive decline. It has been shown that aging impacts working memory, speed processing and executive functions. The STAC model explains that with aging, there is an adaptation and a reorganization of brain functioning. Indeed, new compensatory networks are scaffolded. What is particularly relevant is that this model takes into consideration cognitive intervention, and this is important, because up to now there is not pharmacological mean to counteract brain degeneration. The cognitive and physical training improve and support cognitive functions, and delay neurodegenerative processes, but their mode of action are somehow different. Thus, in the presented study we asked if there would be any interest to combine these two aspects in one training intervention. To respond to this question, we evaluated the contribution of physical activity to cognitive training in term of impact on cognition.

Method : An inter-subject study was designed to evaluate the impact of multiple interventions. There were 2 groups: Cognitive training vs. Combined Cognitive-and-Physical training. Measures on executive functioning, and especially flexibility, task switching, visual attention, inhibition, updating and speed processing were used to investigate the impact of cognitive and physical training on the aging brain.

Results : The study is currently arriving to the end and we will be able to analyze our data for presenting them on the conference. However, preliminary results show that cognitive and cognitive-

and-physical trainings improves differently cognitive performance. The cognitive-and-physical training improves rather speed processing, whereas cognitive training improves rather updating in working memory.

**Discussion :** There is a beginning of a demarcation between the two types of training. Physical aspect seems to provide a general improvement of speed processing, whereas cognitive aspect seems to bring improvement of answer's quality.

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.. 09:20 – 09:40 (22) ..

**Inhibition of the dorsolateral prefrontal cortex facilitates phonological sequence learning in adults.** ARNAUD SZMALEC<sup>1,2</sup>, ELEONORE SMALLE<sup>1</sup>, MURIEL PANOUILLERES<sup>3</sup> & RIIKKA MÖTTÖNEN<sup>3</sup>; <sup>1</sup>*Université catholique de Louvain, Belgium*; <sup>2</sup>*Ghent University, Belgium*; <sup>3</sup>*Oxford University, United Kingdom*

Adults do not learn languages as easily as children do. It has been proposed that late-developing executive functions interfere with procedural mechanisms that support some aspects of language learning, such as learning novel phonological sequences, i.e., word-forms. We used transcranial magnetic stimulation (TMS) to investigate whether a disruption of the Dorsolateral Prefrontal Cortex (DLPFC) – a brain region that supports executive functions - can improve procedural learning of phonological sequences in adults. Young adults were presented with repeating audio-visual sequences of syllables for immediate serial recall in a Hebb repetition learning task that promotes novel word-form learning. Inhibitory theta-burst TMS was applied to the left DLPFC or to the control site before the Hebb task. The DLPFC-disrupted group showed improved recall for the repeating Hebb sequence compared with the control group, indicating enhanced learning of the hidden syllable-sequence. Moreover, Hebb learning was negatively correlated with the executive functions in the control group. The results support the hypothesis that mature frontal lobe mechanisms, in particular executive functions, reduce the ability to learn novel phonological sequences. The findings provide new insight into competing cognitive and procedural mechanisms that contribute to language learning in the mature brain.

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.. 09:40 – 10:00 (23) ..

**Developmental changes in Focal and Nonfocal Prospective Memory tasks.** ANA B. CEJUDO GARCÍA, ALMUDENA ORTEGA SEGURA & M. TERESA BAJO MOLINA; *University of Granada, Spain*

**Background**

Prospective memory (PM) is involved every

time we form a plan to perform a future activity. Performance in PM tasks increases from childhood to adulthood (Zimmermann & Maier, 2006), although age differences seem to depend on whether the PM task involves nonfocal or focal target events. The aim of the study was to evaluate developmental differences in the neural correlates underlying performance in focal and nonfocal PM tasks.

**Method**

Three groups of children (6, 8 and 10 years-old) were evaluated with 2 PM tasks (focal and nonfocal). The ongoing task consisted of categorizing pictures as animals (or non-animals). In the focal PM task, children were asked to change their answer when a particular target appeared, while in the nonfocal PM task children pressed the PM target key when the picture frame had a particular color.

**Results**

Behavioral results showed different developmental trends for focal and nonfocal tasks when looking at accuracy: there were no significant accuracy differences in the focal task, while there was a significant tendency to perform better with age for nonfocal PM. RT data showed that both focal and nonfocal tasks were performed faster as children become older, with the nonfocal task producing slower responses at all ages.

Electrophysiological recording showed a negative deflection over the posterior regions related to the cue detection (N300; West, 2007) and a positive modulation at parietal and frontal regions associated to the detection of low probable events (P300b, Luck, 2005) and the retrieval of intentions from memory (West and Krompinger, 2005). These two components were modulated by the age and the nature of the PM task (focal vs nonfocal).

**Discussion**

The pattern of behavioral and EEG data suggests that there are different developmental trajectories for focal and nonfocal PM task with larger age differences for the more difficult nonfocal task.

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.. 10:00 – 10:20 (24) ..

**Eyes are windows to the dopaminergic brain: color vision predicts processing modes of goal activation during action cascading.** BRYANT JEDEDIAH JONGKEES, LAURA STEENBERGEN & LORENZA SERENA COLZATO; *Leiden University, Netherlands, The*

One of the most important functions of cognitive control is action cascading: the ability to cope with multiple response options when confronted with various task goals. A recent study implicates a key role for dopamine (DA) in this process, suggesting higher D1 efficiency shifts the action cascading strategy toward a more serial processing mode, whereas higher D2 efficiency promotes a shift in the

opposite direction by inducing a more parallel processing mode (Stock et al., 2014). Given that DA is found in high concentration in the retina and modulation of retinal DA release displays characteristics of D2-receptors (Peters et al., 2000), color vision discrimination might serve as an index of D2 efficiency. We used color discrimination, assessed with the Lanthony Desaturated Panel D-15 test, to predict individual differences in a stop-change paradigm that provides a well-established measure of action cascading. In this task it is possible to calculate an individual slope value for each participant that estimates the degree of overlap in task goal activation. When the stopping process of a previous task goal has not finished at the time the change process towards a new task goal is initiated (parallel processing), the slope value becomes steeper. In case of less overlap (more serial processing), the slope value becomes flatter. As expected, participants showing better color vision were more prone to activate goals in a parallel manner as indicated by a steeper slope. Our findings suggest that color vision might represent a predictor of D2 efficiency and the predisposed processing mode of goal activation during action cascading.

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.. 10:20 – 10:40 (25) ..

**Coordinated neural, behavioral, and phenomenological changes in perceptual plasticity through overtraining of synesthetic associations.** NICOLAS ROTHEN<sup>1,2,3</sup>, DAVID J. SCHWARTZMAN<sup>1,4</sup>, DANIEL BOR<sup>1,4,5</sup> & ANIL K. SETH<sup>1,4</sup>; <sup>1</sup>Sackler Centre for Consciousness Science, University of Sussex, Brighton, UK; <sup>2</sup>Department of Psychology, University of Sussex, Brighton, UK; <sup>3</sup>Institute of Psychology, University of Bern, Switzerland; <sup>4</sup>Department of Informatics, University of Sussex, Brighton, UK; <sup>5</sup>Department of Psychology, University of Cambridge, UK

Synesthesia is associated with unusual additional perceptual experiences, which are automatically and consistently triggered by specific inducing stimuli. Synesthesia is also accompanied by more general sensory and cortical changes, such as enhanced modality-specific cortical excitability. Extensive cognitive training has been shown to generate synesthesia-like phenomenology but whether these experiences are accompanied by neurophysiological changes characteristic of synesthesia remains unknown. Addressing this question provides a unique opportunity to elucidate the neural basis of perceptual plasticity relevant to conscious experiences. In a series of experiments we investigate whether extensive training of grapheme-color associations leads not only to synesthetic experiences, but also to changes in cortical excitability. Using a structured interview, we confirm that overtraining synesthetic associ-

ations results in synesthetic phenomenology. Using electroencephalography and transcranial magnetic stimulation before and after training, we find enhanced visual evoked potentials (in response to untrained patterns) and lower phosphene thresholds, demonstrating specific cortical changes. Behavioral tasks before and after training further reveal synesthesia-like performance. Control studies confirmed these results were due specifically to grapheme-color training. A passive control without training, confirmed that these results were not due to repeated testing. An active control with an analogous training regime associating abstract symbols with graphemes led to similar behavioral changes but, crucially, not neural changes or widespread phenomenological changes characteristic of synesthesia. In summary, we demonstrate cortical changes following training that are characteristic of genuine synesthesia. Collectively, our data reveal dramatic plasticity in human visual perception, expressed through a coordinated set of behavioral, neurophysiological, and phenomenological changes.

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## Symposium: On the Challenges that Cognitive Psychology Currently Faces H8, Monday, 09:00 – 10:40

.. 09:00 – 09:20 (26) ..

**Psychology and the open science revolution.** CHRIS CHAMBERS; Cardiff University, United Kingdom

Psychological science has yielded extraordinary discoveries about cognition, but to what extent can we rely on everyday research practices to uncover the truth? In recent years, it has become clear that much research in psychology is based on weak evidence, questionable practices, and occasionally even fraud. In this talk I will diagnose some of the major problems besetting the discipline, including our vulnerability to powerful biases that undercut the scientific method, how we routinely torture data until it produces outcomes that can be published in prestigious journals, and how studies are much less reliable than advertised. While these problems have been known since the 1950s, it is only in the last 5 years that the field has finally moved to address them. I will argue that psychology faces two possible futures: a continuation of current practices leading to scientific obscurity, or a revolution to embrace open practices leading to



greater integration with biology, computer science and physics. I will discuss some of the major reforms that are in progress, including initiatives to incentivise and encourage open archiving of data, study materials, and pre-registration of study protocols. I will focus in particular on the reformative potential of Registered Reports, a journal-based pre-registration scheme that attempts to neutralise various forms of bias by conducting peer review before study outcomes are known.

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.. 09:20 – 09:40 (27) ..

**Two (seemingly opposing) challenges for cognitive psychology.** FREDERICK VERBRUGGEN; *University of Exeter, United Kingdom*

For decades, cognitive psychologists have tried to open the mind's black box. I share the optimists' view that we have learned much about the human mind in the last decades. Nevertheless, specialist black boxes are still omnipresent in the current literature (Verbruggen, McLaren, Chambers, 2014). I claim that this is at least partly due to confusing tasks or functions of the cognitive system (e.g. withholding a response) with cognitive mechanisms (e.g. a motor-inhibition mechanism, triggered when a relevant cue is detected). To succeed, I believe that cognitive psychology (as a field) will have to become even more precise and search for the elementary building blocks of the mechanisms under investigation and the cognitive system as a whole. Furthermore, researchers should clearly specify at which level of analysis they are working (e.g. the computational, algorithmic, or implementation level; Marr, 1982). At the same time, we should keep in mind that greater precision can lead to further theoretical fragmentation (which is arguable already a reason for concern). Thus, the cognitive project can only succeed if there is enough attention for synthesis, not only within the cognitive domain but also across domains. Only then we (cognitive psychologists) will be able to develop satisfactory theory or framework of the cognitive mind.

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.. 09:40 – 10:00 (28) ..

**Neuroimaging might finally be relevant for cognitive science and psychology.** HANS OP DE BEECK; *KU Leuven, Belgium*

Cognitive psychology is not what it was 3 decades ago. One of the major transformations has been caused by the rise of human brain imaging. Is this a blessing or a curse? From the start and along the way the usefulness of neuroimaging has been criticized (e.g., Uttal, 2001, "The new phrenology"). Through a short historic overview, I will argue that such criticism was very relevant in the

early days but became less pertinent over the years. Human brain imaging is a moving target, and the move has been one away from phrenological localization towards an increased focus upon information processing and computations. A major factor has been the development and integration of sensitive methods to measure representational content and functional connectivity. I will illustrate the current state-of-the-art with a few case studies.

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.. 10:00 – 10:20 (29) ..

**A reflection on the scientific goals of cognitive psychology.** JAN DE HOUWER; *Ghent University, Belgium*

One could argue that cognitive psychology has the goal to describe the mental (i.e., informational) processes that mediate the impact of the environment on behavior. Achieving this goal is challenging because it deals with a nonphysical subject matter (i.e., information). To circumvent this problem, researchers often turn to problematic research practices such as the use of behavioral, physiological, or neurological proxies of mental entities. Other researchers change their goals (e.g., the goal to understand the brain), thus effectively abandoning cognitive psychology (e.g., become neuroscientists), or see the goals of cognitive psychology as being at the service of other, distal goals (e.g., the goal to predict and influence behavior). I discuss some of the implications of these three responses to the complexity of cognitive psychology (use proxies, switch to neuroscience, formulate distal goals) and argue that researchers can benefit from being more explicit about their scientific goals.

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## Higher Cognitive Functions H1, Monday, 12:50 – 14:30

.. 12:50 – 13:10 (30) ..

**Executive control, working memory capacity and fluid intelligence: Investigating the Bermuda Triangle.** ALODIE REY-MERMET<sup>1,2</sup>, MIRIAM GADE<sup>1,2</sup>, ALESSANDRA SOUZA<sup>1</sup>, CLAUDIA VON BASTIAN<sup>1,3</sup> & KLAUS OBERAUER<sup>1</sup>; <sup>1</sup>*University of Zurich and University Research Priority Program „Dynamics of Healthy Aging“; <sup>2</sup>Catholic University of Eichstätt-Ingolstadt; <sup>3</sup>Bournemouth University*

In the last two decades, three cognitive psychometric constructs have been said to be closely related: executive control (EC, i.e., the ability to supervise thoughts and actions), working memory

capacity (WMC, i.e., the ability to retain a limited amount of information) and fluid intelligence (gF, i.e., the ability to reason with novel information). However, previous studies have found it difficult to establish a strong correlation between EC and the other two constructs. This might arise from differences in measurement: EC is measured through reaction times, whereas WMC and gF are measured through accuracy. The present study investigates the relationships between the three constructs when EC is also measured through accuracy. The results showed good reliabilities for all measures. Yet, whereas WMC and gF measures correlated strongly with each other, they correlated only weakly with EC measures. Structural equation modeling identified a model with WMC and gF factors, but no model including an EC factor. Measuring EC through accuracy does not overcome the difficulties with establishing EC as a psychometric construct. These findings challenge the assumption that WMC and gF are related to an ability to supervise thoughts and actions.

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.. 13:10 – 13:30 (31) ..

**Removal of Information from Working Memory Relates to Working Memory Capacity and Fluid Intelligence.** KRIS SINGH, ULLRICH ECKER & GILLES GIGNAC; *University of Western Australia, Australia*

The ability to update the contents of working memory (WM) is crucial to keep WM contents current and tuned to the requirements of higher cognitive functions. An active, item-wise removal process has been proposed as the core component process of WM updating. Removing outdated or irrelevant information also minimises interference and allows for more focussed processing of relevant information. We used a novel updating task battery to isolate the core updating process of removal, and measure removal efficiency at the latent variable level. In this talk, I present evidence from three studies showing that removal efficiency process (1) relates to WM capacity, (2) relates to fluid intelligence (gF), and (3) is a unique predictor of gF. First, I report data from two individual-differences studies, analysed with a series of confirmatory factor analytic models. Study 1 revealed that removal efficiency and WM capacity are significantly related, indicating that individuals who are more efficient at removing outdated information have a greater WM capacity. Study 2 revealed that removal efficiency and gF are significantly related, indicating that individuals who are more efficient at removing also have higher levels of gF. Finally, Study 3 was a modelling exercise investigating the inter-associations between removal, WM capacity, and gF. A mediation analysis revealed that removal ef-

iciency had both an indirect effect on gF, mediated by WM capacity, and a direct effect on gF over and above the effect mediated by WM capacity. The latter result suggests that removal ability contributes to performance in reasoning tasks, presumably via facilitated discarding of unhelpful operators during problem-solving.

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.. 13:30 – 13:50 (32) ..

**Predicting performance in cognitive ability tests through measures of working memory span and cognitive control in a game-based assessment.**

EMILY BOARDMAN<sup>1</sup> & LARA MONTEFIORE<sup>2,1</sup>; <sup>1</sup>*Arctic Shores, United Kingdom*; <sup>2</sup>*University College London, United Kingdom*

Gamification and serious games are increasingly presented as a potential disruptive force in cognitive assessment. Working memory (WM) span and cognitive control mechanisms have been established as critical components of performance in cognitive ability tests across multiple experimental paradigms.

A digital version of the Corsi block task and the Simon task were carefully replicated in to game format. Pre-testing established an expected distribution of WM span; the Simon effect was also successfully replicated; response times and accuracy were lower in incongruent trials, while performance was improved on congruent trials.

181 candidates to a programme recruiting traffic controllers completed a game-based assessment in addition to established measures of cognitive ability used in selection: Saville reasoning tests and the Revelian Cognitive Ability Test (RCAT), encompassing numerical, verbal, and abstract reasoning.

Game-measured WM span was moderately to strongly positively correlated with Saville's diagrammatic and spatial reasoning in terms of speed, accuracy and overall percentile, as well as with RCAT score, with the game-based measure of cognitive control mechanisms also correlated with all Spatial reasoning factors, RCAT score, and speed in Diagrammatic reasoning. A logistic regression analysis was also conducted, finding that game-measured WM span made a significant contribution to the prediction of application success.

Collectively, the results suggest that game-based assessments can make a valuable contribution to the prediction of cognitive ability within a selection context.

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.. 13:50 – 14:10 (33) ..

**Suddenly realizing a correct solution is connected to feelings of Aha! in insight problem solving of magic tricks.** AMORY H. DANKE, JOSHUA WILLIAMS & JENNIFER WILEY; *University of Illinois at Chicago, United States of America*

Two hallmarks of insightful problem solving are thought to be suddenness in the emergence of solution due to changes in problem representation, and the subjective Aha! experience. However, little work has demonstrated a connection among these cognitive and affective solution features. We used importance-to-solution ratings as a way to track participants' problem solving process and hypothesized that solutions exhibiting sudden-change patterns ("insight-like" solutions) would be more likely to be connected to Aha! experiences than those with incremental-change patterns. Further, we predicted that Aha! experiences would be more likely to accompany correct solutions than incorrect ones.

Participants viewed a set of magic tricks with the task of finding out how each trick works. After three viewings of the same trick, they made importance-to-solution ratings of six action verbs, including one target verb that implied the correct solution. Subsequently, participants were prompted to indicate to what extent they had experienced an Aha! and to give a solution. Target verb rating patterns that increased by more than 40% of the rating scale at one timepoint were coded as sudden, while patterns showing multiple smaller changes were coded as incremental.

Correct solutions led to higher Aha! ratings than incorrect. Further, within correct solutions, sudden-change patterns led to higher Aha! ratings than incremental-change patterns.

This finding demonstrates a connection between the cognitive aspect of suddenly realizing the correct solution and the affective appraisal of the solution as resulting from an Aha! experience, offering the first empirical support for a close relationship between theoretical constructs that have traditionally been assumed to be related to insightful problem solving.

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.. 14:10 – 14:30 (34) ..

**Insightful problem-solving: The relationship between generating a solution, the subjective "aha!" experience, and long-term memory encoding.** JASMIN M. KIZILIRMAK<sup>1</sup>, BJÖRN H. SCHOTT<sup>2</sup>, BERIT WIEGMANN<sup>3</sup> & ALAN RICHARDSON-KLAVEHN<sup>3</sup>; <sup>1</sup>*University of Hildesheim, Germany*; <sup>2</sup>*Leibniz Institute for Neurobiology, Germany*; <sup>3</sup>*Otto-von-Guericke-University of Magdeburg, Germany*

Recent evidence suggests that solving problems

through insight can enhance long-term memory for the problem and its solution. However, the operationalization of insight differs widely across studies. Some studies require only the generation of a solution to a specific type of problem as a criterion for "insight", others require a subjective feeling of "aha!", and again others require both. The question arises in which way learning from insight differs from the classical generation effect, i.e., better later memory for generated compared with presented solutions, and how the "aha!" experience is involved. Here, we investigated the relationship between generating a solution, the "aha!" experience, and two kinds of memory measures: indirect (solving old and new problems at test) and direct (recognition memory). To this end, we used an adapted Compound Remote Associates Task (CRAT). At encoding, we manipulated whether participants had the chance to solve a problem and compared later memory for generated solutions that were either generated (generate condition), presented after failing to generate one (fail-to-generate condition), or presented without a chance at generation (read condition). Participants also reported if they had an "aha!" experience for each problem. While both "aha!" experiences and generated solutions were independently associated with more positive emotional responses, only the generation variable was associated with differences in later memory performance. The "aha!" experience was not related to later learning, a finding we replicated in several times using the CRAT. Attempts to generate had an advantage over the read condition in recognition memory performance (generate > fail-to-generate > read). However, the solution rate of old items during the memory test was only enhanced when generation was successful (generate > read > fail-to-generate). This results pattern differs from the classical generation effect and suggest that learning from insight is indeed a different type of learning. Email: kizilirmak@uni-hildesheim.de

## Memory

H2, Monday, 12:50 – 14:30

.. 12:50 – 13:10 (35) ..

**Forgetting the importance of a good night's sleep: The relationship between overnight sleep and everyday memory.** ANNA RUTH WEIGHALL & IAN KELLAR; *University of Leeds, United Kingdom*

Sleep has a crucial role to play in memory. Memories are strengthened and consolidated overnight; and sleep can protect against forgetting (Diekelmann & Born, 2010). Moreover, poor sleep

can reduce daytime functioning (Buysse, 2014) and has longer term implications for a range of negative health outcomes and emotional problems e.g., stress, anxiety and depression (Grandner, Patel, Hale, & Moore, 2010). Extant research investigating sleep and memory is primarily lab based, and relationships between sleep; everyday memory; and health and well-being have not been explored. We present data from the Sleep Habits UK survey of a representative sample of 1081 adults (aged 18-80).

Everyday memory performance (short version of the Everyday Memory Questionnaire, adapted from Sunderland, Harris & Baddeley, 1983) was found to be positively correlated with sleep duration, and with reported satisfaction with sleep quality and quantity ( $p < .001$ ). Furthermore, a strong positive relationship between memory and both 'mental' and 'physical' subscales of Quality of Life (QoL; measured by the SF-8) was also observed (both  $p < .001$ ), but was strongest for the mental component. Regression analyses revealed that poor sleep significantly predicted lower outcomes on the mental components of health-related QoL, and that 50% of this relationship was explained by the effect of sleep on memory, which in turn affects QoL. Furthermore, the relationship between memory and health related quality of life was 2.75 x larger for those experiencing very poor sleep ( $< 5$  hours per night) than in a sample of people are sleeping "normally" ( $> 7$  hours per night). This is the first study of its kind to reveal such a compelling relationship between overnight sleep and (a) health, well-being and quality of life and (b) everyday memory – the kind of memory slips we all face at home and at work.

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.. 13:10 – 13:30 (36) ..

**Using wearable cameras to support event memory in early-stage Alzheimer's disease.** ALI MAIR, GEORGE GEORGIU & MIKE PAGE; *University of Hertfordshire, United Kingdom*

Recent memory impairment is a hallmark of Alzheimer's disease, and may have negative effects on social relationships and sense of self. In this study, people with early-stage Alzheimer's disease and age-matched controls (patients' spouses or caregivers) wore chest-mounted cameras to record a series of three prescribed events, which were the same for all participants. The events were experimenter-led tours of local attractions, which were matched for the amount and type of information that was presented. Consolidation of event memory and the subjective sense of reliving the event was tracked across four days immediately following each event. On each occasion participants' memory of the event was tested in a combined procedure consisting of free recall immedi-

ately followed by cued recall. There were three cued recall conditions: written description, still images, and video clips, and each participant recalled one event in each condition. Half of the material from each event was presented during the cued recall procedure, and half remained unseen, which allowed us to determine whether the consolidation procedure supported memory for material that was not subsequently re-encountered. In addition, psychological and general wellbeing measures were administered pre- and post-intervention, and memory for all events was measured again at a longer-term follow-up. The findings will be discussed in terms of their contribution to the literature on memory consolidation and the implications for designing better memory support systems for people with dementia.

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.. 13:30 – 13:50 (37) ..

**How many faces do people know? Estimating upper and lower bounds.** ROB JENKINS, ANDREW DOWSETT & MIKE BURTON; *University of York, United Kingdom*

Despite decades of psychological research into face perception, no one has attempted to estimate the number of faces that people know. It is perhaps surprising that such a basic question has gone unaddressed for so long. In linguistics, the number of words that people know (vocabulary size) has been intensively studied, and has clear implications for word reading and other verbal abilities. By analogy, the size of one's vocabulary of facial identities may explain variation in people's ability to recognise faces. In this talk, I will describe recent work in which we estimate the size of this vocabulary for the first time. I will report likely upper and lower bounds for this estimate as well as large individual differences.

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.. 13:50 – 14:10 (38) ..

**Attentional orienting and recognition memory: memorability is key.** JAVIER ORTIZ<sup>1</sup>, BRUCE MILLIKEN<sup>2</sup>, LUIS JIMÉNEZ<sup>3</sup> & JUAN LUPÍÁÑEZ<sup>1</sup>; <sup>1</sup>*Universidad de Granada, Spain*; <sup>2</sup>*McMaster University, Canada*; <sup>3</sup>*Universidad de Santiago de Compostela, Spain*

Memorability – namely, how well an item is remembered independently of the specific situations under which it is encountered – is a very interesting yet highly puzzling concept. What are the defining characteristics of a highly memorable item? Under which circumstances can poorly remembered items be better retrieved? The study of the relations between memorability and attention can shed some light on the issue and help us better un-

derstand by which mechanisms this construct operates. In this research line, we explore the interaction between memorability and selective attention by means of a validity paradigm. Across different experiments, participants were confronted with words preceded by valid or invalid cues. Memory was later on tested with a surprise word-recognition memory test. Our results show that memorability interacts with attentional orienting in two opposite ways: while memory for initially poorly remembered words is improved under valid conditions, memory for words that are idiosyncratically well remembered is enhanced following invalid cues. These results are discussed in the terms of subjective familiarity, increased elaboration and distinctive tagging.

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## Multitasking H5, Monday, 12:50 – 14:30

.. 12:50 – 13:10 (39) ..

**Separate resource pools for output systems in multiple-action control?** LYNN HUESTEGGE & ALEKS PIECZYKOLAN; *Würzburg University, Germany*

Performing two actions simultaneously usually yields performance costs. According to multiple resource frameworks of multiple action control, the amount of interference should be co-determined by the combination of output (effector) systems involved: When two actions are executed within the same output system performance should be worse (since both actions draw on a common limited resource pool) than when two actions are executed in different output systems (thus drawing on separate resource pools). In a series of two experiments, we tested this prediction by examining dual-response costs of the same manual action (pressing upper vs. lower key with the right hand) when accompanied either by another manual action (intra-modal action: pressing upper vs. lower key with the left hand) or by an oculomotor action (cross-modal action: upward/downward saccade). Across experiments, we varied spatial cross-response compatibility to additionally analyze the role of response congruence. Our results showed that manual responses were executed faster when combined with another response in the same (vs. different) modality. This result was obtained for both spatially compatible (Experiment 1) and incompatible (Experiment 2) responses. Our observations question the assumption of separate resource pools for output systems. Instead, they are more in line with

the assumption of additional cognitive demands related to response modality selection or activation in cross-modal action control. Corresponding implications for theories of multiple action control are discussed.

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.. 13:10 – 13:30 (40) ..

**The Role of Self-Regulation Ability and Information Processing Strategy in Media Multitasking Behaviour.** AGNIESZKA POPLAWSKA-BORUC<sup>1</sup>, EWA SZUMOWSKA<sup>2</sup>, MAŁGORZATA OSOWIECKA<sup>1</sup>, JAKUB KUŚ<sup>3</sup> & JUSTYNA KRAMARCZYK<sup>4</sup>; <sup>1</sup>SWPS University of Social Sciences and Humanities, Campus in Sopot, Poland; <sup>2</sup>Jagiellonian University, Poland; <sup>3</sup>SWPS University of Social Sciences and Humanities, Campus in Wrocław, Poland; <sup>4</sup>Adam Mickiewicz University in Poznań, Poland

Ophir, Nass and Wagner (2009) demonstrated that those who frequently multitask with media exhibit poorer multitasking performance. Other studies, however, have not replicated this effect (e.g. Minear, Brasher, McCurdy, Lewis, Younggren, 2013). The aim of our studies was to demonstrate whether frequent media multitasking is related to poorer multitasking performance depends on participants' self-regulation ability and external conditions such as manipulation of task execution strategy (sequential vs. free switching). In Study 1, apart from participants' media multitasking frequency, we measured their self-regulation ability. Then, we asked participants to perform a multiple media task in which participants could freely switch between browser tabs. The results showed that high media multitasking levels were associated with more switches between tabs but only for those with low (but no high) self-regulation ability. No differences in performance were found. In Study 2, instead of measuring self-regulation ability, we manipulated strategy to execute the task (as an external form of regulation). As predicted, the negative relationship between media multitasking frequency and multitasking performance (overall task score) was obtained only in the free switching condition. No performance decrements were found in the sequential condition. Interestingly, a positive relationship between media multitasking frequency and multitasking performance was found in this condition suggesting that frequent media multitaskers can perform better under some circumstances. The results shed new light on the relationship between media multitasking frequency and multitasking performance by showing its boundary conditions. They also help to explain contradictory findings in the media multitasking literature.

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.. 13:30 – 13:50 (41) ..

**The Impact of Perceptual Predictability on Multi-Task Performance.** LAURA BROEKER<sup>1</sup>, HARALD EWOLDS<sup>2</sup>, STEFAN KÜNZEL<sup>2</sup>, RITA F. DE OLIVEIRA<sup>3</sup> & MARKUS RAAB<sup>1,3</sup>; <sup>1</sup>*German Sport University Cologne, Germany*; <sup>2</sup>*University of Augsburg, Germany*; <sup>3</sup>*London South Bank University, UK*

Research suggests a beneficial impact of predictability on dual-task cost reduction, e.g. through perceptual cues or anticipation. In this study we investigated whether the display of advance visual information in a tracking task, and the provision of fixed tone-sequences in an auditory reaction time task (RTT), help to decrease dual-task costs. We hypothesized that visual information support feedforward control, promoting movement planning and a shift of attention to the auditory RTT. Similarly we hypothesized that auditory information support sequence learning, thereby lowering reaction times and enabling a shift of attention to the tracking task.

Participants performed a manual pursuit-tracking task following a target square on a sinusoidal path while concurrently responding to high-pitched tones by pedal press (ignoring low-pitched tones). In the first experiment parts of sinusoidal tracking path were visualized (0 - 800 ms ahead of target square). In the second experiment high- and low-pitched tones in the RTT were sequenced to a 3:1 sequence. In the third experiment tones were again sequenced, but participants were no longer asked to ignore low-pitched sounds, but to use both feet to respond to tones.

Results of the first experiment show that advance visual information improve performance in the tracking task but not performance in the RTT. Similarly results of the second experiment demonstrate a beneficial impact of sequences on RT, and a significant Condition x Sound Order Interaction, but no benefits for tracking. Under additional cognitive and motor load (Exp.3) participants still benefit from sequences, but the Interaction was no longer significant.

We suggest that perceptual information only benefit the modality it targets, either because they are insufficient to free enough resources to cope with dual-task requirements or because they fool participants into believing the perceptual information emphasizes the importance of the task and the choice of neglecting the other task.

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.. 13:50 – 14:10 (42) ..

**Memory for multiple intentions.** TIMO MÄNTYLÄ<sup>1</sup>, VEIT KUBIK<sup>1,2</sup> & FABIO DEL MISIER<sup>1,3</sup>; <sup>1</sup>*Stockholm University, Sweden*; <sup>2</sup>*Humboldt-Universität zu Berlin, Germany*; <sup>3</sup>*University of Trieste, Italy*

Prospective memory (PM) requires responding

to specific cues while being engaged in other activities. Past research has considered PM as dual-task phenomenon in that these cues refer to one and the same task domain, while many everyday activities refer to different goals and task domains. We hypothesized that reliance on simplified dual-task paradigms in past PM research may have obscured the role of spatial relation processing for offloading executive control demands in more complex task conditions. To test this spatiotemporal offloading hypothesis, participants completed time-based PM tasks with deadlines referring either to the same task (single PM) or different tasks (multiple PM), along with separate tasks of executive functioning (working-memory updating) and spatial ability (mental rotation). Results showed that spatial ability incrementally explained performance in multiple-PM, but not in single-PM, performance, even after controlling for individual differences in executive functioning and primary-task performance. We also observed gender differences in PM in that males outperformed females in multiple-PM, but not in single-PM, performance, and that this gender effect was fully mediated by spatial ability. These findings suggest that spatial relation processing contributes to PM performance, possibly by representing patterns of temporal relations in spatial terms, and thereby alleviating accentuated cognitive control demands in memory for multiple intentions.

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.. 14:10 – 14:30 (43) ..

**The influence of task switching on prospective memory: Coordinating multiple goals in younger and older adults.** ALEXANDRA HERING<sup>1</sup>, STÉPHANIE CAUVIN<sup>1</sup>, ROBERT WEST<sup>2</sup>, NICOLA BALLHAUSEN<sup>1</sup> & MATTHIAS KLIEGEL<sup>1</sup>; <sup>1</sup>*Université de Genève, Switzerland*; <sup>2</sup>*DePauw University, USA*

In everyday life, intentions and plans are embedded within multiple other tasks that have to be performed. We have to keep in mind to pay our bills after work while doing laundry and preparing dinner. Remembering intentions is an important cognitive function for successful everyday life. The aims of the present study were 1) to examine how young and old adults monitor for the appropriate moment to retrieve an intention; and 2) how young and old adults coordinate different tasks to execute the intention after retrieval. We combined a task switching paradigm with a prospective memory task. 30 young adults (18-30 years) and 30 old adults (60-80 years) worked on a switching task where they had to either decide whether a digit was below or above 5 or an odd or even number. They performed each task either alone (pure blocks) or switched between the two

tasks (mixed blocks). Furthermore, the task switching paradigm was performed alone and with an additional prospective memory instruction. The digits were surrounded by colored letters. Participants had to press a specific key whenever a vowel appeared in blue or yellow. Analyses revealed that an additional prospective memory instruction had a negative impact on the task switching performance especially for old adults indicating that old adults had difficulties balancing the switching tasks and the additional intention. Further analyses indicated differences between the age groups in event-related potentials of interest (e.g., frontal slow wave activity). Results were discussed on a behavioral level regarding age differences in prospective memory. Especially, older adults seem to have more difficulties to coordinate multiple task sets. Furthermore, neural correlates of monitoring and post-retrieval processes were integrated to explain the behavioral findings. Monitoring processes were more frontally modulated, particularly in older adults.

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## Reading and Language H6, Monday, 12:50 – 14:30

.. 12:50 – 13:10 (44) ..

### **Does L2 proficiency enhance or interfere with speech fluency in adults who stutter?**

LIZE VAN DER LINDEN<sup>1</sup>, BERNADETTE PIÉRART<sup>1</sup>, DE PARTZ MARIE-PIERRE<sup>1</sup>, DUYCK WOUTER<sup>2</sup>, MORENHOUT CAROLINE<sup>3</sup> & SZMALEC ARNAUD<sup>1</sup>; <sup>1</sup>Université catholique de Louvain, Belgium; <sup>2</sup>Ghent University; <sup>3</sup>BVBA Algemene Aanpak Stotteren

The influence of bilingualism on stuttering remains largely unknown. The Vicious Circle hypothesis argues that stuttering is due to hypersensitivity in speech production (Vasic & Wijnen, 2005). Accordingly, excessive attentional resources are deployed to the detection of errors in the speech plan. Therefore, stuttering frequency is expected to decrease when less attentional resources are available. It is widely accepted that speaking in a second language (L2) requires more attentional resources than speaking in the first language (L1) due to the inhibition of the dominant language (Green, 1998). If stuttering and bilingual language control tap on the same attentional system, stuttering frequency should be lower in L2 because attention is dedicated to the inhibition of L1, reducing hypersensitivity to the speech plan. We tested this hypothesis in a sample of 30 bilinguals who stutter. They were required to perform a network description task in

both their L1 and L2, once as a single task, and once under dual-task conditions where attentional resources were depleted through the introduction of a secondary tone discrimination task. First, in line with the Vicious Circle hypothesis, we observed a decrease of stuttering frequency under dual-task conditions in both languages. Second, contrary to our predictions, we observed a higher stuttering frequency when the network description task was performed in L2 than in L1, suggesting that more attention is dedicated to monitoring speech in L2 than in L1. Furthermore, we found that highly proficient bilinguals also stuttered more in their L1 than those bilinguals who did not fully master their L2, which further supports the view that the inhibition of a nontarget language increases the attentional resources that are used for speech monitoring. We discuss the implications of these findings for theorizing about the interaction between stuttering, attention and bilingualism

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.. 13:10 – 13:30 (45) ..

### **The Phonological Mediation in Writing Depends on Characteristics of the Priming Task.**

OPHÉLIE DE SOUSA OLIVEIRA, ERIC LAMBERT & THIERRY OLIVE; *CeRCA UMR 7295 - CNRS, University of Poitiers, France*

The role of phonology in handwriting is still in debate. According to the obligatory phonological mediation hypothesis, activation of phonological codes is systematically required to recover orthography (Damian, et al., 2011). By contrast, the orthography autonomy hypothesis suggests that orthographic codes can be retrieved without mobilizing phonological codes (Roux & Bonin, 2011). In two experiments, we tested if the phonological mediation depends on characteristics of the priming task. We presented the primes visually (Experiment 1, with phonological and orthographic codes) or orally (Experiment 2, with only phonological codes). We used a task inspired by the Stroop task, with words as primes and colors as targets. The participant had to write the colors' name while ignoring the primes. The primes and the targets were 1/ phonologically and orthographically related (they shared their first phonemes and first letters, e.g., ORANGE – ovale (oval)); 2/ only phonologically related (they only shared their first phoneme, e.g., ORANGE – auteur (author)); or 3/ unrelated (e.g., ORANGE – cabane (hut)).

In Experiment1 (reading), priming occurred only in the phonological-orthographical condition in comparison to the two-other conditions. The analysis of writing durations exhibited the opposite pattern. In Experiment 2 (hearing), priming occurred again in the phonological-orthographical condition, and also in the phonological condition

in comparison to the unrelated condition. The analysis of writing duration exhibited no significant difference.

In these studies, retrieval of orthographic codes depended on how they were primed: An orthographical facilitation appeared only when reading the primes. By contrast, a phonological facilitation was observed only when hearing the primes. Globally, the phonological mediation depended on characteristics of the priming task.

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.. 13:30 – 13:50 (46) ..

**The role of motor knowledge in graphic symbol recognition.** LOLA SEYLL & ALAIN CONTENT; *ULLB, Belgium*

Recent data suggest that motor knowledge plays a crucial role in the recognition of graphic symbols. Learning symbols through handwritten copy gave rise to better recognition than learning by typing on a keyboard, indicating that the type of motor activity involved while learning new characters affects subsequent recognition performance. However, handwriting and typing do not differ only by motor activity. Copying requires to reproduce all elements of the target and thus to construct a detailed visual representation of it. Conversely, typing does not require such detailed processing since a global matching between the target and the corresponding key is sufficient. The present study attempted to disentangle the respective contributions of analytic processing and motor knowledge. We compared copying and typing to a composition learning condition which involves the analysis of the symbols without the graphomotor component. Participants composed the target symbols by selecting elementary features from the set displayed on screen and dragging them in the appropriate position.

Adults participants learned sets of unfamiliar graphic symbols either by copying, typing or composing, and recognition tests were administered immediately after the learning phase and again three weeks later. In Experiment 1, subjects who learned through copying or composing were more accurate than those who learned through typing both immediately as well as three weeks after learning. Experiment 2 controlled exposure time by equating trial duration across conditions. This constraint affected composing more than other conditions. In Experiment 3, learning exposure was limited either in the number of trials or in the duration. In both situations, composing and copying gave rise to better recognition performance than typing. In sum, across experiments, copying gave rise to the best and typing the poorest symbol recognition. When sufficient learning time was allowed, learning by composing led to levels of performance equi-

valent to learning by copying.

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.. 13:50 – 14:10 (47) ..

**Visual feedback in written word production.**

BETTY LAROCHE, THIERRY OLIVE & CYRIL PERRET; *CNRS-Université de Poitiers, France*

Much work on the role of visual feedback in handwriting has shown how vision helps to control graphomotor processes. A recent study showed however that the visual feedback also affects the orthographic processes in handwriting (Perret & Laganaro, 2013). In two experiments, we attempted to further specify how visual information during word writing affects central processes. In a first experiment, thirty-five participants performed a picture naming task on 193 pictures with normal and inkless pen. Reaction times (RT) analysis replicated Perret and Laganaro's (2013) findings: RTs were shorter when participants were deprived of visual information. Although orthographic errors were more numerous in the inkless condition than in the normal condition, we did not observe any interaction between the RT predictors and the visual conditions, suggesting that suppression of visual feedback did not impact writing latencies. Therefore, to further understand the role of visual feedback on orthographic processing we conducted a second experiment in which we focused on writing durations. Thirty-one participants performed the same picture naming task with a new set of 92 pictures. We replicated findings of Experiment 1 on latencies. Moreover, writing durations were longer when participants could not visually monitor their production. These findings indicate that suppression of visual feedback impacted the time course of the orthographic processes: Some of the orthographic processes that normally take place during latencies are delayed during handwriting when participants are deprived of visual information.

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.. 14:10 – 14:30 (48) ..

**The role of orthography in native and nonnative spoken word production.** QINGQING QU<sup>1</sup> &

MARKUS DAMIAN<sup>2</sup>; <sup>1</sup>*Key Laboratory of Behavioral Science, Institute of Psychology, Chinese Academy of Sciences, Beijing, China*; <sup>2</sup>*School of Experimental Psychology, University of Bristol, United Kingdom*

For literate individuals, does the spoken production of native and non-native languages involve access to orthographic codes? Previous research on native language has rendered mixed results, with a few positive findings contrasting with a range of null findings. It has been even less clear whether orthographic codes are activated in spoken word production in non-native languages. In the cur-



rent experiments, we chose spoken Mandarin as the target language in order to better dissociate sound from spelling. Mandarin speakers (in Experiment 1 and 2) and Tibetan-Chinese bilinguals (in Experiment 3) named coloured line drawings of common objects with adjective-noun phrases (e.g., /lan2/ /hualping2/, “blue vase”). Adjectives and nouns were semantically and phonologically unrelated on all trials, but on critical trials they shared an orthographic radical. We found that for both Mandarin native and Tibetan-Chinese nonnative speakers, orthographic overlap resulted in a significant facilitatory effect on naming latencies, and the orthographic effect for non-native speakers was more pronounced. These findings indicate that orthographic information is involuntarily accessed in native and non-native spoken-word production alike, and that it play a more important role in the latter compared to the former.

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## Cognitive Neuroscience II

### H7, Monday, 12:50 – 14:30

.. 12:50 – 13:10 (49) ..

**An fMRI investigation of a Mirror Neuron System for walking.** ANTONELLO PELLICANO<sup>1</sup>, GIANLUCA MINGOIA<sup>2</sup>, HARSHAL PATEL<sup>1</sup>, GIOVANNI BUCCINO<sup>3</sup> & FERDINAND BINKOFSKI<sup>1</sup>; <sup>1</sup>*Division for Clinical and Cognitive Sciences, Department of Neurology Medical Faculty, RWTH Aachen University, Aachen, Germany;* <sup>2</sup>*Brain Imaging Facility IZKF, Medical Faculty, RWTH Aachen University, Aachen, Germany;* <sup>3</sup>*Dipartimento di Scienze Mediche e Chirurgiche, Università Magna Graecia, Catanzaro, Italy*

The mirror neuron system (MNS) is a set of brain areas active during execution of actions, as well as during observation and imagination of the same actions. MNS have been supposed to help us understand the actions and intentions of other people. Activation of mirror neurons has been basically observed for hand actions; however poor evidence is available for actions performed with legs. We performed a functional magnetic resonance (fMRI) study to investigate the common neural structures recruited during the execution, observation, and imagination of walking.

A block design experiment was conducted on twenty healthy participants. While lying in a 3T scanner, participants were instructed to walk on a rolling cylinder installed on the MR bed (walking condition), watch a video of someone walking on the same cylinder (watching condition), and imagine walking on it with eyes closed (imaging condition).

Brain activation in the three conditions was consistent with the corresponding perceptual/motor tasks. In particular, the walking condition activated the leg area of motor cortex and Supplementary Motor Area (SMA); the imaging condition activated an area including pre-SMA; the observation condition activated areas in primary and secondary visual cortex. Conjunction analyses were run to investigate common areas of activation. The walking and watching conditions shared bilateral activation of Rolandic Operculum (OP1) that is part of the secondary Somatosensory cortex (S2); whereas walking and imaging conditions shared the activation of a left posterior-medial frontal area that is part of the SMA.

We observed common activations for action execution and observation in S2 (Keysers et al., 2004), whereas for execution and imagination common pre-SMA activation was identified (Mukamel et al., 2010). The results suggest that two different mirror neurons areas would govern the association between action execution-observation and action execution-imagination.

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.. 13:10 – 13:30 (50) ..

**The Mirror Neuron System (MNS) affects autonomic regulation of respiration.** GIANLUCA MINGOIA<sup>1</sup>, ANTONELLO PELLICANO<sup>2</sup>, HARSHAL PATEL<sup>2</sup>, GIOVANNI BUCCINO<sup>3</sup> & FERDINAND BINKOFSKI<sup>2</sup>; <sup>1</sup>*Brain Imaging Facility IZKF, Medical Faculty, RWTH Aachen University, Aachen, Germany;* <sup>2</sup>*Division for Clinical and Cognitive Sciences, Department of Neurology Medical Faculty, RWTH Aachen University, Aachen, Germany;* <sup>3</sup>*Dipartimento di Scienze Mediche e Chirurgiche, Università Magna Graecia, Catanzaro, Italy*

The MNS is a set of brain areas active during the execution of motor actions, as well as the observation and imagination of the same actions. Activation of the MNS has been supported by several brain imaging and behavioral studies; however, poor investigation has been done on correlates of motor activity in the autonomic system. As part of an fMRI experiment that investigated the common neural structures recruited during the execution, observation, and imagination of walking, we investigated the effects of these three conditions on cardiac and respiratory activity by recording both heart and breath signals.

Twelve participants lied in a MRI scanner and performed 3 tasks: to walk on a rolling cylinder installed on the MRI bed (walking condition), watch a video of someone walking on the same cylinder (observation condition), and imagine walking on it with eyes closed (imagination condition). Three corresponding baselines were given: to push the cylinder with the feet, watch a clip of an actor push-

ing it, and to imagine pushing it. Cardiac and respiratory activities were recorded through a dedicated device in order to obtain 4 indexes: hearth rate (hr), hearth rate variability (hrv), respiration rate (rr), respiration rate variability (rrv).

All indexes showed significantly higher values in walking than in observation and visualization conditions irrespective of task/baseline performance. A higher rr was observed in the task compared to the baseline for walking, but crucially also for observation and imagination.

Similar to actual motor performance, observing and imaging a motor action (walking) increased the respiration rate compared to observing and imaging an action that required less physical effort (pushing). Such evidence is consistent with the activation of a MNS that also affected the autonomic system modulating the respiration function.

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.. 13:30 – 13:50 (51) ..

**Hemodynamic Correlates of Visuomotor Adaptation Processes to Linear and Circular Rotation Tasks: an fNIRS Study.** AÇELYA YILDIZ<sup>1</sup>, HAKAN ÇETINKAYA<sup>2</sup>, SEDA CAN<sup>1</sup>, SEDA DURAL<sup>1</sup> & GAZİHAN ALANKUŞ<sup>1</sup>; <sup>1</sup>*Izmir University of Economics, Turkey*; <sup>2</sup>*Ankara University, Turkey*

The current study, supported by TUBITAK, utilized functional near-infrared spectroscopy (fNIRS) to investigate the underlying neural mechanisms of adaptation processes to a novel visuomotor rotation task through hemodynamic response. In addition to traditional linear visuomotor mapping rule previously encountered in literature, in this study, a circular (non-linear) visuomotor mapping rule was created and presented via a custom stimulus program developed with Unity game engine. The sampling of the study consisted of 43 college students all of whom were right-handed, healthy and non-smoking individuals. The motor task required participants to move from a starting point with a computer mouse and to hit fifteen targets located around an imaginary circle. The rotation manipulation was employed on the mouse's trajectory with an angle of 45 degrees counter-clockwise. In circular condition, unlike linear condition, straight movements resulted in circular tracks. Participants completed a baseline trial with no rotation before they continued to either linear or circular trials, each consisting of five consecutive laps around the circle. Growth curve analysis was conducted on gradual changes related to both trial completion length and regional oxygenated hemoglobin (oxy-Hb) and deoxygenated hemoglobin (deoxy-Hb) concentration. Trial completion length across five trials indicated task-related expertise development, correlating with decreased movement error and increased precision. The analysis conducted on

data points for each participant's consecutive measurements revealed significantly higher oxy-Hb concentration in circular condition compared to linear condition and significantly lower deoxy-Hb concentration in circular condition than linear condition. It was also revealed that the gradual change in oxy-Hb and deoxy-Hb condition was significantly influenced throughout trials by the type of trajectory manipulation.

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.. 13:50 – 14:10 (52) ..

**Gender-specific Hemodynamic Measures Obtained via Functional Near Infrared Spectroscopy (fNIRS) by Using n-back Task.** İLGİM HEPCARCAN SEZEN<sup>1</sup>, SEDA CAN<sup>1</sup>, GAZİHAN ALANKUŞ<sup>1</sup> & HAKAN ÇETINKAYA<sup>2</sup>; <sup>1</sup>*Izmir University of Economics, Turkey*; <sup>2</sup>*Ankara University, Turkey*

The present study aims to investigate the gender differences in behavioral measures and hemodynamic measures obtained through functional near infrared spectroscopy (fNIRS) which is used in the specification of the executive functions related to the hemodynamic activity of the prefrontal cortex, during a verbal version of n-back working memory task. It is observed in literature that there is no consensus in the results of whether brain activity and behavioral measures of males and females similar or not. In this study, a total of 50 healthy right-handed university students, 29 females and 21 males, took part. A verbal version (letters) of n-back task was computerized and presented via MATLAB. Hemodynamic measurements (oxygenated, deoxygenated, total hemoglobin and oxygenation change) were obtained via the 16-channelled fNIR system. The study consisted of 3 trials and each trial includes four n-back conditions, which were 0-, 1-, 2-, and 3-back, with different orders. Behavioral results indicated that, as n-back conditions increased, the number of detected target and non-target letters decreased, but reaction time during detecting target and non-target letters increased. Also, male and female participants did not vary on the number of detected targets and non-target letters, reaction time during target and non-target letter detection. Channel-wise linear mixed effects analysis showed hemodynamic measurement changes in the prefrontal cortex as parallel with behavioral results.

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.. 14:10 – 14:30 (53) ..

**Fake News in Biofeedback: Sham Feedback on Skin Conductance Responses Modulates Affective Processing.** JAN EHLERS, VERONIKA STRACK & ANKE HUCKAUF; *Ulm University, Germany*

The mechanisms of how cognitive processes in-

fluence states of autonomic activity are crucial for understanding the pathogenesis of stress-related disorders. Biofeedback applications determine individual stress- or fear-related responses by visualizing sympathetic activity changes to aversive stimulation (e.g. on the basis of skin conductance responses (SCR)). Participants become aware of dysfunctional processing mechanisms and are concurrently provided with the opportunity to acquire cognitive techniques and compensate for pathological reactions. In this context, sham feedback constitutes a rarely used control condition in which real-time feedback does not correspond to a subject's actual physiological state. The present study assumes that participants cognitively and physiologically adapt to a suggested reaction provided via manipulated SCR. We applied a within-subject design with the type of feedback (true vs fake SCR) blocked. 32 subjects were exposed to neutral and aversive sounds obtained from the International Affective Digitized Sound system (Bradley & Lang, 1999); associated SCR were displayed simultaneously as signal characteristics on a screen. During manipulated trials, real-time feedback was replaced by previously prepared signal modulation indicating either strong or weak autonomic reactions to stimulus material. Actual SCR were recorded as the dependent variable. According to LaVaque et al. (2002), participants quickly perceive feedback that mismatches their body perceptions. In the current study, four subjects identified the manipulated responses. For the rest, results suggest that physiological responses to fear-related stimuli are considerably weakened when sham feedback indicates absent or only small sympathetic reactions. Here, autonomic activation is reduced to the level of stimulation with neutral sounds. These findings may provide a valuable contribution to therapeutic work by supporting anxiety patients to overcome irrational concerns during the period of systematic desensitisation. Email: jan.ehlers@uni-ulm.de

## Metacognition and Consciousness H8, Monday, 12:50 – 14:30

.. 12:50 – 13:10 (54) ..

**Modern Approaches to Animal Cognition: A Question of Truth or Taste?** DANIEL HANUS; *Max Planck Institute for Evolutionary Anthropology, Germany*

The debate about whether or not one could/should ascribe cognitive abilities to animals

has deep historical roots and seems very up-to-date in light of the immense body of new empirical data originating from various species and research paradigms. For epistemological reasons, false positive findings (type 1 errors) are taken to be more serious errors than false negatives (type 2 errors), which results in a bias against attributing psychological traits to animals as common scientific practice. Associative learning (AL) seems to be the ubiquitous low-level contender for any cognitive interpretation of animal behavior, mostly because of the assumed mechanistic simplicity and phylogenetic prevalence. However, the implicit assumption that AL is simple and therefore the most parsimonious explanation to describe seemingly complex behavior can and must be questioned on various grounds. Using recent empirical findings with chimpanzees as an example, I will argue that at times inferential reasoning might be the better candidate to account for animal performances. Furthermore, it will be discussed more generally if it makes sense to conceptualize associative and inferential approaches to animal behaviour as mutually exclusive descriptions or if they are "simply" reflecting different theoretical perspectives on the same empirical phenomena. If we take the interaction between learning and reasoning seriously we should consider behavioural interpretations of varying complexity including representations and inferential processes in animals.

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.. 13:10 – 13:30 (55) ..

**I do not understand but I care: Cooperation in domestic dogs.** JULIANE BRÄUER; <sup>1</sup>*Friedrich Schiller University of Jena, Germany;* <sup>2</sup>*MPI for the Science of Human History*

There has been a growing interest in animal cognition, i.e. how animals perceive their environment and what they understand about it. Domestic dogs are an especially interesting model, as they have evolved various skills for functioning effectively in human societies. Although the initial reason why dogs were domesticated 15,000 years ago remains unknown, it is likely that they have been selected for cooperating with humans. When dogs cooperate with humans, much of their displayed behaviour might be innate or trained. The question raised here is what dogs understand when they cooperate with others. Do they know their partners' roles and intentions?

To try to answer these questions I present three studies. In the first study pairs of dogs were tested in a problem-solving task. Dogs could easily coordinate their actions in this new paradigm, but it is likely that they independently but simultaneously directed similar actions towards the common goal. In the second and the third study it was investig-

ated whether dogs would help a human, either by informing her about a hidden object or by opening a door for her.

I conclude that when cooperating, dogs are highly motivated to please humans but they have problems understanding others' goals and intentions.

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.. 13:30 – 13:50 (56) ..

**Integrating neuronal and higher-order theories of consciousness: dynamic level interaction model.**

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Current models of consciousness are often limited to visual perception and focus on investigating the threshold of awareness rather than the problem of the subjective character of conscious experience. There is no widely accepted, wide-ranging theory that describes the mechanisms underlying access not only to visual, but also to other types of conscious content (i.e. related to other senses, but also memory, reasoning, or decision making). It seems that a theoretical model is needed that will compromise the philosophical and neurobiological approaches that are trying to address both issues. Here, we propose that this could be achieved with a unification of theories and methods proposed in the context of cognitive and neurobiological studies of consciousness and we offer a new hierarchical model: a dynamic level interaction model that offers an integrative view on the subject. The model aims to account for the possible factors influencing the different levels of the cognitive hierarchy and to describe how the conscious content changes over time. We first present the model, then, we discuss how to test and measure its assumptions, and finally offer some examples of recent studies conducted in our lab that support them.

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.. 13:50 – 14:10 (57) ..

**Age differences in the neural markers of metacognition. Evidence from a financial decision-making task.**

CHIARA SCARAMPI<sup>1</sup>, RICHARD FAIRCHILD<sup>2</sup> & NEAL HINVEST<sup>1</sup>; <sup>1</sup>*Department of Psychology, University of Bath, United Kingdom*; <sup>2</sup>*School of Management, University of Bath, United Kingdom*

In the last years there has been a growing interest in the neural correlates of metacognition, supported by the recognition that it plays an essential role in behaviour regulation and contributes to optimal

decision-making. A large body of research has documented the neural components associated with conflict and error monitoring, whereas the role of metacognitive experiences in relation to these components has not been extensively studied.

The current study uses EEG to dissociate task-related activity from earlier and later metacognitive processes in the context of financial decision-making. It investigates how metacognition modulates four psychophysiological indices that in previous studies have been specifically associated with conflict and error processing: the error-related negativity (Ne/ERN), the error positivity (Pe), the P3, and the N2.

The study also investigate differences between young and older adults in the neural correlates of metacognition, with the aim of understanding how the effects of metacognitive experiences on monitoring and control processes interact and change with age. A better understanding of the interrelation between ageing, metacognition, and ERPs can help to provide a clarification of the contradicting results that characterise the literature on how the neural correlates of performance monitoring change with ageing.

The results of the study may also show that the amplitude of these components constitutes a robust neural measure of metacognitive experiences, which can be used in future research to assess how individuals monitor and control their performance, without requiring them to provide explicit, subjective ratings of their own abilities.

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.. 14:10 – 14:30 (58) ..

**RELATIONSHIP between THEORY of MIND, SOCIAL and METACOGNITIVE SKILLS of CHILDREN.**

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Mind theory is seen as a high-level thinking skill in which metacognitive capacities are used, and high-level thinking skills of children arise from the use of metacognitive capacity (Baron-Cohen, Leslie and Frith, 1985). In the related literature many studies showed that theory of mind skill is associated with social skills. The aim of this study is to examine the mediating role of metacognitive skills within the relationship between social and mental theory skills of children. 120 children aged 9-10 years from different socio-economic levels participated to the study. The age of the children and the socioeconomic status of their families are controlled in this study. In order to determine the children's level of the theory of mind skills "Second Degree False Belief Task" (Stone et al. (1998) and "Faux Pass Task" (Baron-Cohen et al, 1985) were

utilized. The metacognitive skills of children were assessed with the "Metacognitive Awareness Inventory for Children (Sperling, et al., 2002). In addition, the "Social Ability Scale" (Yurdakavuştu, 2012) was implemented to the children to assess the social skills. The analyses of data revealed that there is close correspondence between the theory of mind, social and metacognitive skills of children. The results also showed that children from upper and middle SES families got higher scores on sub-scales theory of mind, metacognitive skills, and social skills scales than the children from lower SES families. It has been found that children aged 10 years have a higher level of mental theory, metacognitive skills and social skills scores than those at age 9 and that there is a meaningful and close relationship between mental theory, metacognitive and social skills of children when age and socioeconomic status are controlled.

**Key words:** Metacognition, theory of mind, social skill, children  
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## Symposium: Insight-Based Problem Solving: The Roles of Convergent and Divergent Thinking and Attentional Processes

### H1, Monday, 14:40 – 16:20

.. 14:40 – 15:00 (59) ..

**Can susceptibility to distraction inform the component processes underpinning verbally-based insight problem solving?** JOHN EVERETT MARSH, EMMA THREADGOLD, MELISSA BARKER & LINDEN BALL; *UCLan, United Kingdom*

Insightful and creative problem solving have been studied in psychological and neuroscience domains using the Compound Remote Associates (CRA) task. The CRA task requires participants to generate a unique word (e.g., tree) that is associated with a triplet of familiar words (e.g., house, family, apple). Despite its popular use, few studies have attempted to identify component cognitive processes underpinning CRA problem solving. Here, we capitalise on the well-known disruptive effects of to-be-ignored distractors on verbal working memory to shed light on component processes underpinning verbal insight problem solving, as involved in solution of CRA problems. Provided they exhibited changes-in-state over time, the mere presence of letter (Experiment 1) and tone (Experiment

2) distractors impaired solutions of CRA problems, suggesting that covert verbal rehearsal/maintenance plays a role in verbal insight problem solving. Moreover, the disruption produced by to-be-ignored sound was exacerbated when it was meaningful (normal speech) as compared with meaningless (spectrally-rotated speech). Since meaningful speech impairs focal semantic processes—such as spreading semantic activation—it would appear that covert articulatory processes and semantic processes interact to determine successful CRA problem solving. The results suggest that covert verbal rehearsal and spreading semantic activation are two component processes that underpin verbal insight problem solving. Results are discussed with reference to multi-process accounts that recognise the roles of both associative and executive processes in creative cognition.

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.. 15:00 – 15:20 (60) ..

**A hidden feature of creativity: Does creative or analytical thinking influence attentional breadth?** MARTA K. WRONSKA & ALINA KOLAŃCZYK; *SWPS University of Social Sciences and Humanities in Poland, Faculty in Sopot*

Conditions improving divergent and analytical thinking have been thoroughly studied in the past research; creative thinking has been consistently shown to benefit from broad attention. However, does engaging in creative or analytical thinking in itself influence attentional breadth? We predicted that solving an open (divergent) vs. closed (analytical) task broadens the attentional field, and that medium (open/closed; Remote Associate Test) task's effect on attention is in between. A task (open vs. medium vs. closed) instruction, along with the response field, was displayed in the middle of the screen, while distractors (geometric shapes and symbols) were located in the peripheries. Participants (N = 138) solved the task; subsequently, they performed a delay task and proceeded to a recognition test including 25 peripheral and 20 filler symbols. Participants indicated whether a symbol was present on the screen during the task solution (0 = definitely no, 1 = definitely yes). A recognition index was computed being the difference between hit rates (i.e., the proportion of peripheral symbols that were correctly classified as present) and false-alarm rates (i.e., the proportion of filler symbols that were falsely classified as present). Higher recognition index indicates broader attention during the task solution. We found that engaging in the task solution affects attentional breadth. Participants in the open task condition had significantly broader attention than participants in the closed task condition (Cohen's  $d = 0.68$ ). However, no significant differences were found between medium

task and the remaining conditions. In the discussion we will compare the moderating role of personality (Need for Closure, which was measured online before the experiment) and breadth of attention on performance in the open, medium, and closed task. We will also discuss potential consequences of choosing different operationalisations of creative tasks (e.g., Unusual Uses Task and Remote Associates Test) on the measurement of cognitive processes.

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.. 15:20 – 15:40 (61) ..

**Comparing differences in predictive power of divergent and convergent thinking in insight problem solving and insight in problem solving.** MARGARET ELIZABETH WEBB, DANIEL LITTLE, SIMON CROPPER & KAYLA ROZE; *The University of Melbourne, Australia*

There is little data regarding individual differences that are associated with the feeling of insight when people solve insight problems despite the large literature on insight problem solving. The ability to generate diverse ideas (divergent thinking) is valuable in solving creative problems (e.g., insight problems); yet, however advantageous, divergent thinking is insufficient to solve insight problems on its own and requires the ability to logically assess the correctness of each solution (convergent thinking). Here we investigated whether intelligence or divergent thinking individually predicts problem solving in insight-type problems across three experiments (total N = 435), and whether intelligence or divergent thinking predicts the experience of insight. In studies one to three, participants were presented with divergent and convergent thinking tasks, insight problems, and non-insight problems. Ratings of aha experience were measured after each problem. In Study 1, we demonstrated a positive relationship between measures of convergent thinking and problem solving but not between convergent thinking and aha experience. We replicated this finding in Study 2 and Study 3. However, the relationship between divergent thinking and insight problem solving was complex, with flexibility of thought a negative predictor of aha experience but a positive predictor of solution accuracy, and with originality of thought as a negative predictor of solution accuracy but a positive predictor of aha experience. These results suggest that convergent thinking is more important than divergent thinking for problem solving, but highlight the complexities associated with scoring creativity, and imply that originality may be poor for insight problem solving but good for feeling insightful.

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.. 15:40 – 16:00 (62) ..

**"Try turning it upside-down!" Contraries facilitate insight in problem solving.** ERIKA BRANCHINI<sup>1</sup>, IVANA BIANCHI<sup>2</sup>, ROBERTO BURRO<sup>1</sup>, ELENA CAPITANI<sup>2</sup> & UGO SAVARDI<sup>1</sup>; <sup>1</sup>*University of Verona, Italy;* <sup>2</sup>*University of Macerata, Italy*

Contraries has been shown to be relevant to many cognitive abilities, such as spatial perception (e.g. Bianchi, Savardi, & Kubovy, 2011), language (e.g. Jones et al., 2012), understanding humor (e.g. Colston & O'Brien, 2002; Canestrari & Bianchi, 2013) hypothesis testing (e.g. Gale & Ball, 2012), relational reasoning (e.g. Alexander, 2012), creativity and divergent thinking (e.g. Duncker, 1945; Rothenberg, 1996).

We will add to this list with recent evidence that thinking in terms of contraries support the thought processes of small groups of people whose task is to solve visuo-spatial insight problems. They were specifically told that systematically transforming the spatial features of each problem into their contraries would help them to find the correct solution. The participants either took part in a training program including explanations of the strategy to follow or they were given hints which acted as a kind of 'priming' (Branchini et al., 2015, 2016, in preparation). The results varied in these two conditions but in general the suggestion to use contraries turned out to be beneficial in terms of success rates and it impacted on the behavior of the groups judging from the drawings they did and their dialogues.

Possible explanations are discussed as to how this might have impacted on the process of representational change necessary to overcome an impasse (Knoblich et al., 2001; Öllinger et al., 2008). We will also relate these findings to the debate on the role of conscious and unconscious processes in non-routine problems (e.g. Gilhooly et al., 2015).  
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.. 16:00 – 16:20 (63) ..

**Somatic markers of positive and negative insight.** GILLIAN HILL & SHELLY M. KEMP; *University of Buckingham, United Kingdom*

Background.

Insight is a sudden new thought, understanding or idea accompanied by an Aha or Uh-oh experience. Previous attempts to identify somatic markers that differentiate between insight and search solving have focused only on positive insight.

Methods and results.

An initial study (N = 79) compared heart rate (HR) changes through positive solving elicited using the Compound Remote Associate (CRA) task. Results identified a biphasic heart rate change response to solving a problem. A reduced HR deceleration was seen in trials labelled as insight compared to search.

A novel task, where participants (N = 80) played Connect 4 was developed to produce both positive and negative, insight and search solving experiences. A reduced HR was again demonstrated for insight compared to search solving. No differences in HR change were seen between positive and negative solving and no interactions occurred between solving type and valence.

Discussion.

These studies demonstrate the possibility of identifying a somatic marker in HR change to discriminate insight and search solving. However, further research to ensure a robust effect across different problem solving tasks and physiological measures is recommended.

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## Symposium: Megastudies and Big Data in Language Research H2, Monday, 14:40 – 16:20

.. 14:40 – 15:00 (64) ..

**Reading through the lifespan: Individual differences in psycholinguistic effects.** ROB DAVIES<sup>1</sup>, RUTH ARNELL<sup>2</sup>, JULIA BIRCHENOUGH<sup>3</sup>, DEBBIE GRIMMOND<sup>4</sup> & SAM HOULSON<sup>5</sup>; <sup>1</sup>Lancaster University, United Kingdom; <sup>2</sup>Exeter University, United Kingdom; <sup>3</sup>Oxford Brookes University, United Kingdom; <sup>4</sup>Reading University, United Kingdom; <sup>5</sup>Bristol University, United Kingdom

The effects of psycholinguistic variables are critical to the evaluation of theories about the cognitive reading system. However, reading research has tended to focus on the impact of key variables on average performance. We report the first investigation examining variation in psycholinguistic effects across the life-span, from childhood into old age. We analysed the performance of a sample of 535 readers, aged 8-83 years in lexical decision and pronunciation tasks. Our findings show that the effects on reading of two key variables, frequency and AoA, decrease in size with increasing age over the life-span. We observed the systematic modulation by age and reading ability of these and other psycholinguistic effects alongside a global U-shaped effect of age. Diffusion model analyses suggest that developmental speed-up in decision responses can be attributed to the increasing quality of evidence accumulation in reaction to words, while the ageing-related slowing can be attributed to decreasing efficiency of stimulus encoding or response execution processes. An analysis of spoken response durations furnishes a consistent picture in

which the slowing of pronunciation responses with age can be attributed to slowing articulatory processes. We think our findings can be explained by theoretical accounts that incorporate learning as the basis for the development of structure in the reading system. However, an adequate theory shall have to include assumptions about both developmental learning and later ageing. Our results warrant a life-span theory of reading.

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.. 15:00 – 15:20 (65) ..

**WordGame: Investigating visual word recognition “in the wild”.** SASCHA SCHROEDER; *Max Planck Institute for Human Development, Germany*

In this talk, I will introduce “WordGame”, a project that examines visual word recognition outside the laboratory and how it changes across the lifespan. WordGame is an interactive exhibit on display in several German museums since 2013. It uses a social, game-like version of the progressive demasking task: In each round, one word – randomly drawn from a pool of 10,000 words – is incrementally displayed to two players. If one of the players recognizes it, he or she can hit a buzzer and type the word using a keyboard. Correct answers yield points needed to win the game. On each trial, response accuracy and latency is recorded. In addition, players are asked to indicate their age at the end of the game. By now, 25,000 persons covering an age range from 6 to 85 years have played this game. First analyses using mixed-effect modelling show that for both response accuracy and latency, non-linear inhibitory effects are found for word length and neighborhood density, while word frequency effects were linear and facilitative. The efficiency of the word recognition process strongly increased during childhood and adolescence, remained stable during early adulthood, and slowly decreased from age 40 onwards. In addition, while length effects differed very little between age groups, frequency and neighborhood effects increased linearly across the lifespan. Together, this indicates that the word recognition system becomes gradually more fine-tuned to lexical information with increasing language experience.

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.. 15:20 – 15:40 (66) ..

**Distributional models and the structure of semantics.** CHRIS WESTBURY & GEOFF HOLLIS; *University of Alberta, Canada*

Notable progress has recently been made on developing distributional models of semantics (Mikolov, Chen, Corrado, & Dean, 2013; Mikolov, Sutskever, Chen, Corrado, & Dean, 2013). These models have largely been applied to practical problems

of meaning representation in natural language processing. Little attention has been paid to their psychological plausibility; however, it is possible they are arriving at quality semantic representations because they learn to organize semantic knowledge along similar dimensions as humans. If that were the case, these models may stand to further our understanding of human learning. We present an empirical analysis of the dimensions over which these models are organizing word meaning, across multiple distribution models and corpora, and compare these results to theories of how humans organize semantic knowledge.

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.. 15:40 – 16:00 (67) ..

**Employing Distributional Semantics in Experimental Studies.** FRITZ GÜNTHER; *University of Tübingen, Germany*

In distributional semantics models (DSMs), word meanings are represented as high-dimensional numerical vectors. These vectors are obtained by observing the distributional pattern of words in large corpora of natural text, for example by counting the number of occurrences with specific contexts. Contexts can be defined as the documents constituting the corpus, or as a set of other words. With these vectors, DSMs allow for computing objective measures of word similarity, by taking the cosine similarity between two word vectors. Previous studies have shown that these cosine similarities can be used to select the correct answer in synonym tests, to predict human judgements of word similarity, and to account for semantic priming effects. However, in the latter case, studies have often re-analyzed item material that has been shown to produce priming effects. Here, I want to argue that there are some problems of interpretability associated with these post-hoc analyses, and that experimental studies actively manipulating DSM cosine similarities as an independent variable are necessary to investigate their effects. In this context, I will discuss work on megastudies data on the one hand, and present an item selection procedure for designing experimental studies on the other hand.

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.. 16:00 – 16:20 (68) ..

**The impact of word prevalence on word processing efficiency: The English data.** MARC BRYLSBAERT<sup>1</sup>, PAWEŁ MANDERA<sup>1</sup> & EMMANUEL KEULEERS<sup>2</sup>; <sup>1</sup>*Ghent University, Belgium*; <sup>2</sup>*Tilburg University, the Netherlands*

Brysbaert et al. (2016) showed that word prevalence is a good predictor of word processing times in the Dutch language. It is defined as the percent-

age of people who know a word. Word prevalence explains 7% of lexical decision times, after the effects of word frequency, age-of-acquisition, word length, and similarity to other words are taken into account. Here we present the English word prevalence norms and discuss their contribution to accounting for the variance of lexical decision and naming times in the English Lexicon Project and the British Lexicon Project. We also discuss the reasons why word prevalence is an important variable to be taken into account in future studies.

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## Symposium: Tracking the Focus of Attention in Visual Working Memory

H5, Monday, 14:40 – 16:20

.. 14:40 – 15:00 (69) ..

**The precision of the focus of attention in visual working memory.** ALESSANDRA S. SOUZA, MIRKO THALMANN & KLAUS OBERAUER; *University of Zurich, Switzerland*

Attention helps to manage the contents of visual working memory (vWM). Perceptual attention selects what is encoded into vWM, whereas internal attention sets the priorities for retrieval of information stored therein. The present study assessed the precision of allocation of perceptual and internal attention in vWM. Participants encoded an array of six colored dots. After a brief interval, a probe appeared in one of the memory locations, and participants judged whether its color matched the one shown at that location. To manipulate attention, a cue indicated the item most likely to be tested (70% validity). The cue appeared either before the onset of the memory array (pre-cue) or during the retention interval (retro-cue). The pre-cue guides perceptual attention to gate encoding into vWM, whereas the retro-cue guides internal attention for retrieval of the cued item from vWM. If attentional selection is imprecise, attention should spread from the cued location to spatially nearby uncued locations. If this is the case, memory for colors in uncued locations should vary as a function of their distance to the cued location. Compared to a no-cue baseline condition, tests of the validly cued item yielded benefits, whereas tests of uncued locations yielded costs. The spatial distance between the uncued and the cued location only modulated the costs for testing an uncued color in the pre-cue condition: neighbors of the pre-cued color were insulated from cueing costs. These results show that perceptual attention



shows a graded selectivity over space. In contrast, selection of items for retrieval within vWM is constrained to a single item.

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.. 15:00 – 15:20 (70) ..

**Actions as attentional cues for selective weighting in visual working memory.** ANNA HEUER & ANNA SCHUBÖ; *Philipps-Universität Marburg, Germany*

Representations in visual working memory (VWM) can be weighted to reflect differences in task-relevance. Experimentally, task-relevance is typically indicated by retrocues presented during the retention interval, but under natural conditions, the relevance of visual objects is mostly determined by action intentions. In a series of experiments, we investigated whether actions also induce a weighting of VWM representations according to action-relevance. This investigation built on two mechanisms of action-related selective processing known to influence perception: The deployment of spatial attention to action goals, and the selective weighting of action-related feature dimensions. In a combined memory and movement task, participants memorized items and performed a movement during the retention interval. This was either a pointing movement towards a specific location, or a particular type of movement. In experiments with pointing, memory was better for items presented at locations corresponding to the movement goal than at action-irrelevant locations, especially when memory load was high. Performance at locations next to the movement goal was better than at locations farther away, consistent with an attentional gradient spreading out from the action goal. Experiments with different types of movements revealed that representations are also weighted according to differences in the action-relevance of specific feature dimensions. Memory for items defined by size was better during the preparation of grasping movements than during the preparation of pointing movements. Conversely, memory for colour tended to be better when a pointing movement was being planned. Whereas size is a relevant feature dimension for grasping, colour can be used to localize a goal object and guide pointing. Taken together, these findings show that actions modulate visual processing not only during perception, but also during short-term retention. This action-related updating optimizes the efficient use of capacity-limited VWM, and ensures that information required for upcoming actions is easily available.

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.. 15:20 – 15:40 (71) ..

**Spatially selective alpha oscillations reveal moment-by-moment tradeoffs between working memory and attention.** DIRK VAN MOORSELAAR<sup>1</sup>, JOSHUA J. FOSTER<sup>2</sup>, DAVID W. SUTTERER<sup>2</sup>, JAN THEEUWES<sup>3</sup>, CHRISTIAN N. L. OLIVERS<sup>3</sup> & EDWARD AWH<sup>2</sup>; <sup>1</sup>*University of Amsterdam, Netherlands, The;* <sup>2</sup>*Chicago University;* <sup>3</sup>*VU university*

Current theories assume a functional role for covert attention in the maintenance of spatial information in working memory. Consistent with this view, both the locus of attention and positions stored in working memory can be decoded based on the topography of oscillatory alpha-band (8-12 Hz) activity on the scalp. Thus far however, alpha modulation has been studied in isolation for covert attention and working memory tasks. Here we applied an inverted spatial encoding model in combination with electroencephalography (EEG) to study the temporal dynamics of spatially specific alpha activity during a task that required observers to visually select a target location while maintaining another, independently varying location in working memory. During the memory delay period, alpha-based spatial tuning functions shifted from the position stored in working memory to the covertly attended position, and back again after the attention task was completed. The findings provide further evidence for a common oscillatory mechanism in both the selection and the maintenance of relevant spatial visual information, and demonstrate the dynamic trade-off in prioritization between two spatial tasks.

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.. 15:40 – 16:00 (72) ..

**Within and Beyond the Focus of Attention: What are the Implications of Attentional Prioritization on Multifeature Objects in Visual Working Memory?** MUHAMMET I. SAHAN<sup>1,2</sup>, ANDREW D. SHELTON<sup>2</sup> & BRADLEY R. POSTLE<sup>2</sup>; <sup>1</sup>*Ghent University, Belgium;* <sup>2</sup>*University of Wisconsin-Madison, USA*

Multivariate pattern analyses of neuroimaging data from the two-step retrocuing paradigm have highlighted an important question about the physiological consequences of selection in visual working memory (VWM): whereas selection invariably strengthens the neural representation of cued information, what is its influence on uncued information, which must nonetheless still be retained in VWM? In studies in which discrete objects were held in VWM, evidence for the active representation of the “uncued-memory-information” (UMI) dropped to baseline (e.g., Lewis-Peacock, Drysdale, Oberauer & Postle, 2012). However, when just one multi-feature object was held in VWM, and retrocues prioritized particular features of it (e.g.,

visual, semantic, phonological), the UMI retained an intermediate level of elevated activity relative to the selected feature and the baseline (Lewis-Peacock, Drysdale, & Postle, 2015). This raises the possibility that the “same-object” benefit in visual processing, attributed to object-based attention, may also exist for VWM. To address this question, we carried out an fMRI study in which two multidimensional objects (colored dots drifting coherently in one direction) were presented as memoranda, followed by two levels of retrocues: an initial “general cue” indicated whether one of the two objects or one of the two feature dimensions (i.e., the two colors or the two motion directions) would be relevant for that trial; then, each of two serially occurring “feature cues” indicated which feature would be tested by the impending memory probe. The neural time course of the feature representations was tracked by fitting the data to a multivariate forward encoding model. Results provide evidence for a “same-object” benefit in VWM. In all conditions, after a retrocue the neural strength of UMI decreased over time. When the UMI was bound into the same object as the cued feature, however, it remained significantly active across delay. In contrast, when the UMI was not bound to the cued stimulus, its neural representation dropped to baseline.

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.. 16:00 – 16:20 (73) ..

#### **Rapid forgetting in working memory in disease.** NAHID ZOKAEI; *university of Oxford, United Kingdom*

The mechanisms underlying rapid forgetting in working memory are extremely controversial. New methods to measure the precision of visual short-term memory (VSTM) using continuous responses (rather than binary yes/no reports) provide a sensitive probe. These are tasks where participants are asked to firstly keep in mind a feature of an item (i.e. orientation/location) and following a short delay, are asked to reproduce the exact quality of the remembered feature. Here we use these techniques to examine rapid forgetting in different patient groups to reveal different signatures of deficit. We show that patients with Parkinson's disease (PD) and a population at risk of developing PD (patients with rapid eye-movement sleep behavior disorder) have increased vulnerability to random corruption of visual short-term memory over just seconds. By contrast, individuals with Alzheimer's disease (AD) and mild cognitive impairment demonstrate increased “misbinding” of object features. These are errors where other items in memory systematically corrupt memory for an item- in this case, patients were likely to locate an item in the location of one of the other items

in memory. Similarly, performance of a group of individuals with hippocampal sclerosis matched that of those seen in AD patients. Together these findings provide evidence for development of cognitive tools for early detection of neurodegenerative conditions.

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### **Symposium: Exploring the Sense of Agency from Sensorimotor Processes to Joint Action: A Hierarchical Perspective** **H6, Monday, 14:40 – 16:20**

.. 14:40 – 15:00 (74) ..

**Action monitoring and the sense of agency.** NURA SIDARUS<sup>1</sup>, MATTI VUORRE<sup>2</sup>, PATRICK HAGGARD<sup>3</sup> & VALERIAN CHAMON<sup>1</sup>; <sup>1</sup>*Institut Jean Nicod, Ecole Normale Supérieure, PSL Research University, Paris, France*; <sup>2</sup>*Columbia University, New York, US*; <sup>3</sup>*Institute of Cognitive Neuroscience, University College London, UK*

Human voluntary action is typically accompanied by a sense of agency (SoA), that is, the feeling of being in control of one's actions and, through them, of events in the outside world. Much research has shown that the SoA depends on a retrospective matching between the expected and actual outcome of an action. However, recent studies have revealed an additional, prospective component to the SoA, related to monitoring conflict during action selection. Although conflict monitoring has been well studied, this field has remained largely separate from research on outcome monitoring and SoA. Our research aims to bridge this gap by assessing the relation between conflict and outcome monitoring processes, and the relation between conflict monitoring and SoA. In an event-related potentials (ERPs) study, subliminal priming of actions was used to induce response conflict. Participants responded to imperative stimuli, and observed action outcomes. Subjective agency ratings were collected at the end of each trial. Results show that incompatible priming disrupted action selection, and led to a reduction in SoA over action outcomes, relative to compatible priming. ERPs revealed that signals associated with SoA emerged already at the time of the action. This indexed an action monitoring process that signalled disruptions in action selection, and was linked to a reduction in SoA. Thus, we show that action monitoring signals influence SoA prospectively, as they emerge long before the

outcome is known. Additionally, outcome monitoring was also related to SoA. Yet, there was no interaction between the neural correlates of action and of outcome monitoring. Importantly, SoA is best understood as resulting from an integration of prospective signals, related to action monitoring, with retrospective signals, based on outcome monitoring. Yet, prospective and retrospective components may make independent contributions to SoA.

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.. 15:00 – 15:20 (75) ..

**Metacognition of agency: A meta-analytic review of agency cues.** MATTI VUORRE<sup>1</sup>, NURA SIDARUS<sup>2</sup> & JANET METCALFE<sup>1</sup>; <sup>1</sup>*Columbia University, United States of America*; <sup>2</sup>*Institut Jean Nicod, France*

#### Background

Early and influential cognitive models of the sense of agency (SoA)—the sense of controlling one's actions and through them, outcomes in the world—focused on feedback signals in the sensorimotor system. Namely, the comparator model posited that SoA results from a lack of discrepancy between an action's predicted feedback and the actual sensory feedback. Subsequent research has found the antecedents to SoA to be much broader in scope and not limited to information in the sensorimotor system. What exactly these "cues to agency" are and how they are combined to inform SoA remains an active area of investigation.

#### Method

20 experiments using a dynamic computer game task probed various possible influences to SoA. Participants used a computer mouse to move the game cursor to capture and avoid items on the screen, and judged their SoA (and experienced performance) at the end of every 20s trial. Broadly, experimental manipulations targeted cues relating to sensorimotor discrepancy, effort, goal monitoring, context, and other cues that might be used to inform SoA. We investigate the interplay of the various sources of information using meta-analytic and path-analytic techniques.

#### Results

SoA does not arise simply from a lack of discrepancy between predicted and obtained sensorimotor feedback, but rather is multiply determined by many sources of information—as suggested by cue combination models. Some of these cues are informative to the actual degree of control, and some are only heuristically informative (i.e. associated with control in everyday situations).

#### Discussion

SoA is a thin yet pervasive experience, and reflects information gleaned from multiple sources. Current analyses support the idea that cue integration models more appropriately describe the experience of agency than alternative accounts based

purely on sensorimotor feedback.

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.. 15:20 – 15:40 (76) ..

**Disorders of Agency in Schizophrenia.** AXEL LINDNER<sup>1,2</sup>, MANUEL J. ROTH<sup>1,3</sup>, KLAUS HESSE<sup>4</sup>, DIRK WILDGRÜBER<sup>4</sup>, HONG-YU WONG<sup>2</sup> & MARC J. BUEHNER<sup>5</sup>; <sup>1</sup>*Hertie-Institute for Clinical Brain Research, University of Tuebingen, Germany*; <sup>2</sup>*Werner Reichardt Centre for Integrative Neuroscience, University of Tuebingen, Germany*; <sup>3</sup>*International Max Planck Research School for Cognitive and Systems Neuroscience, Tuebingen, Germany*; <sup>4</sup>*Dept. Psychiatry and Psychotherapy, University of Tuebingen, Tuebingen, Germany*; <sup>5</sup>*School of Psychology, Cardiff University, United Kingdom*

Delusions of influence (DoI) are a first-rank symptom and hallmark of schizophrenia. Patients suffering from DoI lack the feeling of control over their thoughts and actions. Here we tested whether such disturbed "sense of agency" could be captured with a temporal binding paradigm. Temporal binding describes the fact that intentional causal actions and the sensory events triggered by them are bound together in subjective time: The sensory outcome of an intentional action is perceived as happening earlier in time than an identical sensory event preceded by a non-intentional signal. Such "intentional" outcome binding can be considered an implicit marker of the sense of agency and, accordingly, should be altered in patients suffering from DoI.

To test this prediction we compared temporal outcome binding between 10 schizophrenia patients with DoI, 10 schizophrenia patients without DoI, and 20 healthy controls. While the latter control group exhibited significant temporal outcome binding, binding was absent in the group of schizophrenia patients with DoI. Instead, the group of patients without DoI revealed binding effects that were even stronger than those of controls. Finally, temporal estimates of all Schizophrenia patients were generally less predictive in that they were rather following than anticipating intentional and non-intentional outcomes.

Our results confirm that disorders of agency in schizophrenia (i.e. the presence of DoI) correlate with reduced temporal binding. These results are paralleled by our earlier findings which demonstrate that patients with DoI have imprecise forward models and are (therefore) impaired in distinguishing self- and externally- caused events (Lindner et al., 2005, *Current Biology*; Synofzik et al., 2010, *Brain*). We suggest that imprecise forward models could likewise explain the absence of temporal binding in patients with DoI and their overreliance on sensory feedback.

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.. 15:40 – 16:00 (77) ..

**Loss of agency in social context.** FREDERIKE BEYER<sup>1</sup>, NURA SIDARUS<sup>2</sup>, SOFIA BONICALZI<sup>1,3</sup>, STEVE FLEMING<sup>4</sup> & PATRICK HAGGARD<sup>1,3</sup>; <sup>1</sup>*University College London, United Kingdom*; <sup>2</sup>*Institut Jean Nicod, Département d'Etudes Cognitives, Ecole Normale Supérieure, PSL Research University*; <sup>3</sup>*School of Advanced Study, University of London*; <sup>4</sup>*Wellcome Trust Centre for Neuroimaging, University College London*

Sense of agency is typically investigated as an individual process, with other people merely serving as a source of ambiguity of authorship. However, a large proportion of human behaviour occurs in social settings, and the presence of others can exert substantial effects. Here, we investigate how social context affects individual cognitive processes and sense of agency, and propose a novel model of diffusion of responsibility. Specifically, we suggest that other people act as a source of dysfluency in the action selection process, decreasing both outcome monitoring and sense of agency.

We investigated sense of agency during voluntary action in social and non-social contexts. Participants made a costly action in order to prevent greater monetary loss, either alone or in the presence of a co-player, who was able to act instead of the participant. Participants always knew whether they or the co-player had caused an outcome; thus, there was no ambiguity of authorship. Nevertheless, participants reported a reduced sense of agency over action outcomes in the social context. In an ERP study, we showed that outcome monitoring, reflected in the amplitude of the feedback-related negativity, was reduced on trials in which participants acted in the presence of the co-player. In a subsequent fMRI study, we showed that activity in the precuneus was both increased by social context and negatively related to sense of agency.

Based on these findings, we propose that in social situations, mentalizing about the co-player may make action planning more difficult, as the other's intentions and potential actions have to be taken into account. This dysfluency then results in a subjective loss of control over action outcomes. Thus, for a full understanding of how sense of agency emerges, the role of social contexts needs to be taken into account.

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.. 16:00 – 16:20 (78) ..

**Sense of agency in joint action: where is the we?** ELISABETH PACHERIE; *Institut Jean Nicod - PSL Research University, CNRS, France*

Engagement in joint action may involve a transformation of agentive identity and a partial or complete shift from a sense of self-agency to a sense of we-agency. I explore several ways in which our ex-

perience of joint agency may differ from our experience of individual agency. First, the mechanisms of action specification and control involved in joint action are typically more complex than those present in individual actions, since it is crucial for joint action that people coordinate their plans and actions. I examine the implications of these coordination requirements for agentive identity. Second, joint actions may involve asymmetries in the size or importance of individual contributions and in power-distribution among agents. Finally, motivational and affective factors also play an important role in shaping our experience of joint agency.

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## Symposium: Neurocognitive Aspects of Math Anxiety H7, Monday, 14:40 – 16:20

.. 14:40 – 15:00 (79) ..

**Experiencing more anxiety than expected? Trait and state mathematics anxiety in high achieving students.** ANNA-LENA ROOS<sup>1,2</sup>, MADELEINE BIEG<sup>1</sup>, THOMAS GOETZ<sup>1,2</sup>, ANNE FRENZEL<sup>3</sup>, JAMIE TAXER<sup>4</sup> & MOSHE ZEIDNER<sup>5</sup>; <sup>1</sup>*University of Konstanz, Konstanz, Germany*; <sup>2</sup>*Thurgau University of Teacher Education, Kreuzlingen, Switzerland*; <sup>3</sup>*Ludwig-Maximilians-University, Munich, Germany*; <sup>4</sup>*Stanford University, Stanford, CA, USA*; <sup>5</sup>*University of Haifa, Haifa, Israel*

Anxiety is a widespread and detrimental emotion in school, particularly in the domain of mathematics. The present study examined mathematics anxiety among high and low achieving students (N = 237, grades 9 and 10) by contrasting trait (habitual) and state (momentary) assessments of mathematics anxiety. Previous research revealed that in comparison to state measures which reflect actual experience of (momentary) anxiety, values based on trait measures are often biased due to being recall based and thus strongly influenced by subjective beliefs. In this respect, academic self-concept has been found to influence trait anxiety ratings in that the trait-state discrepancy is smaller (i.e., less overestimation of trait anxiety) in students with higher academic self-concepts. Since high achievers can be expected to have a very high academic self-concept, we assumed that, besides reporting lower levels of both trait and state anxiety, the trait-state discrepancy would be relatively low in those students. Results of hierarchical linear modelling confirmed these assumptions and revealed that high achievers even report lower trait than state anxiety.

Our findings imply that even though high achievers appear well adapted to the classroom environment due to lower levels of trait and state anxiety than low achievers, they underestimate their trait anxiety and actually experience more (state) anxiety in mathematics class than they seem to be aware of (i.e., as reported in trait measures). Consequences of this underestimation of trait anxiety in high achievers and directions for future research will be discussed.

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.. 15:00 – 15:20 (80) ..

**Implicit behavioral and physiological measures as assessment tools for math anxiety.** HILIE EIDLIN LEVY & ORLY RUBINSTEIN; *Haifa University, Israel*

The phenomenon of math anxiety (MA) is very pervasive and highly investigated over the last decades. Here, we aimed to investigate whether MA manifestations vary due to measurement method by correlating explicit and implicit MA measures with physiological arousal. In order to measure implicit MA levels, we created the computerized numerical dot probe, based on the canonic dot probe task (MacLeod, Mathews & Tata 1986), measuring attentional bias toward threatening stimuli. A standardized questionnaire was included, measuring explicit MA levels. Furthermore, skin conductance measurement was applied, as high anxiety levels are expressed by earlier and larger skin conductance responses.

Results indicated that high explicit MA levels were also manifested by attentional bias toward math related information. However, skin-conductance responses were associated with implicit but not explicit MA symptoms. Furthermore, as females reported higher explicit MA levels, no gender difference was found for implicit MA levels and increased physiological arousal was correlated with implicit MA levels among the entire sample. Accordingly, math anxiety is a specific state anxiety reaction, which shows inflated physiological arousal. The findings also challenge the belief concerning gender differences associated with MA. Accordingly, we believe that MA manifestations vary due to measurement method, a fact with significant implications for the field of MA assessment and treatment.

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.. 15:20 – 15:40 (81) ..

**Intentional and automatic processing of numerical information in math anxiety, testing the influence of emotional priming.** SARIT ASHKENAZI; *The Seymour Fox School of Education The Hebrew University of Jerusalem, Israel*

Current theoretical approaches suggest that math anxiety (MA) is a weakness in the ability

to manipulate quantities. The present study was the first that examined automatic versus intentional processing of numerical information, using the numerical Stroop paradigm in participants with high MA. The present study combines the numerical Stroop task with an affective priming paradigm in order to manipulate anxiety levels during the task. Neutral primes were words with no emotional meaning while anxiety primes were math words. We compared performance of college students with and without MA. In the low anxiety condition, participant with high MA showed relatively intact number processing. However, trials with anxiety inducing primes, participants with high MA showed 1) higher processing of the non-numerical irrelevant information, in line with the theoretical view that purports a selective attention deficit in anxiety and 2) an abnormal numerical distance effect. These results demonstrate that numerical processing difficulties in MA are situational.

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.. 15:40 – 16:00 (82) ..

**The indirect effects of working memory capacity and self-efficacy level on the math anxiety/math performance relationship.** MOLLY M. JAMESON & MEGAN KEARNS; *University of Northern Colorado, United States of America*

From a cognitive perspective, working memory capacity has been shown to impact math anxious student's performance and one hypothesis for a cause of math anxiety is low working memory capacity. From a social cognitive perspective, however, a person's level of self-efficacy has been shown to be one of the strongest personal factors in the development, expression, and impact of math anxiety. But the question of which is more influential, or if there are differences in who these factors impact, is unanswered. This study seeks to answer those questions using indirect effects analyses. In a sample of US undergraduate students, we are collecting data on math anxiety, math performance, working memory capacity, and level of math self-efficacy. Data collection is currently underway, but preliminary results (N=54) of the indirect effects analyses suggest that working memory capacity has a stronger indirect effect for students with high levels of math anxiety, while math self-efficacy level has a stronger indirect effect for students with moderate levels of math anxiety. This finding provides new information about how cognitive and social cognitive factors may impact students differently and informs interventions should be geared toward different mechanisms for students of differently anxiety levels.

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.. 16:00 – 16:20 (83) ..

**Math anxiety from a Middle-European perspective: Evidence for universality of the construct despite cultural specifics of math education. Insights from the AMAS scale validation in Poland.** KRZYSZTOF CIPORA<sup>1</sup>, KLAUS WILLMES<sup>2</sup> & HANS-CHRISTOPH NUERK<sup>1,3,4</sup>; <sup>1</sup>*University of Tuebingen, Germany*; <sup>2</sup>*Department of Neurology, University Clinic RWTH Aachen University, Aachen, Germany*; <sup>3</sup>*Leibnitz-Institut für Wissenschaften, Germany, Tuebingen, Germany*; <sup>4</sup>*LEAD Graduate School & Research Network*

Math anxiety (MA) has captured researchers' attention for over five decades, due to its role in numerical processing as well as societal importance. Nevertheless, research efforts have not been equally distributed across different linguistic and cultural contexts. For instance, it has rarely been studied in Middle-European countries such as Poland. Information about MA in this region can only be drawn from the Program for International Student Assessment (PISA), which unfortunately does not utilize psychometrically validated MA scales, and considers only adolescents. While general MA levels in Poland are close to the PISA average, gender differences are below the average, the negative correlation between MA and math performance is one of the highest among countries studied. We conducted a validation of the Abbreviated Math Anxiety Scale (AMAS) - one of the most popular MA scales. This comprised three independent samples ( $n = 1720$ ): (1) students tested in a paper-and-pencil format, (2) students tested in an online setup, and (3) adolescents. All three studies show AMAS usefulness in Poland. Reliability and validity (construct, convergent, discriminant) indices were invariant across languages and cultures. Average raw scores were very similar to those obtained in other countries (the U.S., Australia, Italy, Iran). Moreover, we observed administration method invariance, as the results did not differ depending on whether the test was given in a paper-and-pencil or computerized online setup. Thus, AMAS is suitable for measuring MA in varied age groups and in varied linguistic contexts without the need to change the content of scale items. These results provide further support for the universality of the MA itself. Unexpectedly, we observed varied correlation patterns between MA, trait anxiety and math skill depending on participants' field of study. This unexpected discovery is subject to follow-up analysis in studies that are currently underway.

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## Symposium: Perceptual Consequences of Action

### H8, Monday, 14:40 – 16:20

.. 14:40 – 15:00 (84) ..

**Visuomotor and motorvisual priming with different types of set level congruency.** ROLAND THOMASCHKE<sup>1</sup>, R. CHRISTOPHER MIAL<sup>2</sup>, MIRIAM RUESS<sup>1</sup>, PUJA R. MEHTA<sup>3</sup> & BRIAN HOPKINS<sup>4</sup>; <sup>1</sup>*Albert-Ludwigs-Universität Freiburg, Germany*; <sup>2</sup>*Birmingham University, United Kingdom*; <sup>3</sup>*King's College London, United Kingdom*; <sup>4</sup>*Lancaster University*

Perception can prime action (visuomotor priming), and action can prime perception (motorvisual priming). According to ideomotor theory both effects rely on the overlap of mental representations between perception and action. This implies that both effects get more pronounced the more features they share. We tested this hypothesis by employing in a motorvisual (Exp.1) and in a visuomotor (Exp.2) setting, three different pairs of left/right target stimuli (hand pictures, arrows, and words) varying in how strongly they overlap with the pair of left/right responses. For two stimulus pairs (hands and words) the hypothesis was confirmed: Hand pictures share more features with the responses than words, consequently hand pictures produced a stronger visuomotor and a stronger motorvisual priming effect than words. However, arrow stimuli showed a different pattern: The temporal dynamics of both priming effects, as well as the direction of the effect seen in motorvisual priming, were significant but opposite to that of the hand and word stimuli. This suggests that the arrows' representations were not involved in ideomotor processes, and we propose instead that they were represented in a spatial or scalar fashion, outside the representations assumed in ideomotor theory. The results are discussed in the context of ideomotor theory, and the Planning and Control Model (PCM) of motorvisual priming.

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.. 15:00 – 15:20 (85) ..

**Motion detection and planned hand movement: Testing competing theories of action-perception interface.** DAVOOD GOZLI; *University of Macau, Macau S.A.R., China*

One way to elucidate the processes involved in action planning has been to test the perceptual consequences of planned action. A range of experimental findings have been accumulated with this approach. Although the findings do not readily lend themselves to a single theoretical account, several important attempts have been made. I be-

gin by discussing three accounts, Theory of Event Coding (Hommel, Müsseler, Aschersleben, & Prinz, 2001), Planning and Control Model (Thomaschke, Hopkins, & Miall, 2012), and Preactivation Model (Waszak, Cardoso-Leite, & Hughes, 2012). I then introduce two experiments that tease apart the predictions of these accounts. Experiment 1 required participants to detect the presence of coherent motion while having planned an action in a direction congruent or incongruent with the motion. Experiment 2 required participants to decide which of the two stimuli moved first (temporal order judgment), while having planned an action that was congruent with one stimulus motion and incongruent with the other. Theory of Event Coding predicts planned movement to interfere with the perception of congruent motion in both experiments; Planning and Control Model predicts interference if participant treat motion directions categorically (more likely in Experiment 2), and no effect otherwise; Finally, Pre-activation Model predicts interference Experiment 1 and facilitation in Experiment 2. The findings were in line with Preactivation Model, which assumes action planning involves increased activity in the predicted sensory action-outcome, and does not assume occupation (unavailability due to feature integration) of those sensory features.

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.. 15:20 – 15:40 (86) ..

**Sensory surprise in the context of meaningful movement.** GEORGIANA JURAVLE; *INSERM, France*

Goal-directed movement has a consistent effect on (tactile) perceptual processing: Touch is suppressed during action (see Juravle, Binsted, & Spence, 2016, for a review). In this talk I will discuss the contribution of vision and motor planning to the modulation of tactile perception during action. Specifically, I will focus on the various movement stages where the availability of visual information is crucial for the integration of the sensory information with the motor command. I will then present data from recent experiments where we set to investigate any reverse influence, from (predicted) touch to movement kinematics. Specifically, we examined whether and how the visually-conveyed tactile qualities of an object to be grasped affect the kinematics of the executed movement. Participants were presented with either a smooth or carved cylindrical object and instructed to prepare to grasp it. Vision was then occluded for a variable delay during which the object could be replaced (or not), depending on the condition. The return of vision was the go signal for the movement. Participants reached for, grasped, and lifted the object off the table. Because we were interested in how sensory priors might affect the movement

profile, we manipulated the probability of the object being the same/different at the time of the go signal (by blocks: 100%, 50%, and 80%). In an additional block (80% +), a third unexpected 'spiky' object could be presented (only twice). Results indicate that the visually-conveyed tactile attributes of an object consistently affect the transport component of the reach-to grasp movement, as a function of predictability. These results suggest that perception modulates movement in a reverse fashion to the documented suppression. Taken together, I will argue in favour of sensorimotor integration as a bidirectional process, with the motor prediction being adjusted online based on available visual input and sensory priors.

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.. 15:40 – 16:00 (87) ..

**Action shapes duration perception.** DANIEL YON<sup>1</sup>, ROSANNA EDEY<sup>1</sup>, RICHARD IVRY<sup>2</sup> & CLARE PRESS<sup>1</sup>; <sup>1</sup>*Department of Psychological Sciences, Birkbeck, University of London, United Kingdom;* <sup>2</sup>*Department of Psychology, University of California, Berkeley, California*

In recent years considerable attention has been paid to the role that the motor system plays in perceiving the actions of others. However, a preoccupation with 'action simulation' has overshadowed evidence that the motor system contributes to numerous sensory features that are important for perceiving a range of events in our social and physical environments. One such feature is duration. In this talk I will describe psychophysical experiments that reveal a novel bias in duration perception induced by action execution – such that sensory events appear longer when we produce actions that are longer in duration. Our results show that the perceptual biases are indeed generated at a motor locus, and are obtained even when the participant's movements are manipulated implicitly. I will close by describing a recent experiment where we investigated the origins of this bias. We found that reversing the contingencies between action durations and perceptual consequences (e.g. such that when participants produced long movements they experienced short effects) abolished the influence of action on perception. This suggests that the bias may arise through an associative mechanism that tracks the correlation between actions and their likely sensory consequences. In sum, our results suggest that the motor system exerts a top-down influence on duration perception that is acquired as a consequence of sensorimotor experience.

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.. 16:00 – 16:20 (88) ..

**Intentional Binding of two effects.** MIRIAM RUESS<sup>1</sup>, ROLAND THOMASCHKE<sup>1</sup>, CAROLA HAERING<sup>2</sup>, DORIT WENKE<sup>3</sup> & ANDREA KIESEL<sup>1</sup>; <sup>1</sup>Albert-Ludwigs-Universität Freiburg, Germany; <sup>2</sup>Julius-Maximilians-Universität Würzburg; <sup>3</sup>PFH University of Applied Sciences Göttingen

When an action produces an effect, the action is perceived later in time compared to an action without following effect. Likewise, the effect is perceived earlier in time compared to a stimulus without preceding action. Despite a substantial number of studies on this phenomenon - referred to as intentional binding effect (IB) - the underlying mechanisms are still not fully understood. Typically, IB is investigated in settings, where the action produces only one single effect, whereas in everyday action contexts our actions rather cause a sequence of effects before leading to the desired outcome. Therefore, we investigated in four experiments IB of two consecutive effects and observed substantially more IB for a first effect compared to a second effect. Interestingly, the second effect yielded stronger IB when it was less delayed. These results suggest that even effects occurring later in an unfolding action effect sequence can be bound to the causing action; but they might be bound less to actions than effects following actions directly. This, however, seems rather to be caused by the longer delay of a later occurring effect, instead of the fact, that it is the second of two effects.

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## Symposium: Understanding Very Large Numbers H1, Monday, 16:35 – 18:15

.. 16:35 – 16:55 (89) ..

**Children's arithmetical estimation: what happens when numbers get too big for them?** ANN DOWKER; *Oxford University, United Kingdom*

84 children between 5 and 9 were given an addition estimation task. In order to evaluate the children's competence in addition, a mental calculation task was given to each child. This consisted of a list of addition sums, graduated in difficulty from  $4 + 5$ ,  $7 + 1$ , etc. to  $235 + 349$ . The children were divided into four levels according to their performance on the mental calculation task. Four sets of estimation problems were devised, each containing nine items. The sets were designed to be progressively more difficult to solve, based on the size of the numbers in the sums. The set just too difficult for

a child to solve by mental calculation was referred to as their base correspondence. The children were asked to estimate answers to all the sums. They were also children invited to rate other people's guesses to related problems on a five-point 'smiley faces' scale. Children's estimates to problems within their base correspondence were mostly reasonable, and those to problems below their base correspondence were mostly exact. As the problems involved larger numbers above their base correspondence, the children began to use rigid and inappropriate strategies (e.g. to always give the number one above the larger addend) and, as they involved still larger numbers, began to respond randomly. The ratings for estimates below their base correspondence were closely related to the extent to which the estimate deviated from the correct answer: the further from the correct answer it was, the worse it was rated. However, children's ratings within and above their base correspondence were not correlated with the actual accuracy or reasonableness of the estimates. Thus increasing number size in addition problems led to reduced accuracy and to more inappropriate strategy use. It affected performance more severely for evaluations of other people's estimates than for their own estimates.

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.. 16:55 – 17:15 (90) ..

**Processing multi-digit numbers in the context of computation estimation.** DANA GANOR-STERN; *Achva Academic College, Israel*

Past research investigated the representation of multi-digit numbers using mainly the numerical comparison task. It was concluded that large numbers such as 4-digit numbers are not represented holistically but rather as a sequence of digits (Poltrock & Schwarz, 1984).

The present study draws a different conclusion based on an estimation comparison task. In this task a multi-digit multiplication problem is presented together with a reference number and participants estimate whether the exact answer is larger or smaller than this number. The reference numbers are either far (5 times larger or smaller) or close (twice or half) to the exact answer. They are in the range of hundreds to hundred thousands. College students' accuracy in this task is above chance level and it is sensitive to the distance between the reference number and the exact answer, as it is enhanced for far compared to close numbers. Thus, the present results suggest that multi-digit numbers are represented holistically. Such a representation is presumably a product of experience with solving arithmetic problems (Ganor-Stern, 2015).

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.. 17:15 – 17:35 (91) ..

**The role of motion in the conceptualization of limits and continuity in expert mathematics.**

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NA

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.. 17:35 – 17:55 (92) ..

**Is the Symbol of Infinity Perceived as "the Largest"? MICHAL PINHAS; *Ariel University, Israel***

The mental representation of the infinity symbol (i.e.,  $\infty$ ), as well as the understanding of concepts of infinity, have received little research attention in cognitive science. In mathematics, the infinity symbol usually represents a potential infinity, that is, a process that repeats itself and never terminates such as counting. Thus, it is presumably perceived as larger than any given number that corresponds to a concrete magnitude. The present study explored whether the infinity symbol is associated with the special status of "the largest". In a series of experiments, participants performed numerical and physical size comparisons of the infinity symbol with single- and multi-digit numbers. Overall, numerical comparisons yielded slower responses for comparisons between infinity and a number than for comparisons between two numbers. Furthermore, distance effects were obtained for comparisons to infinity, suggesting that the infinity symbol was treated as a number that is larger than all other numbers presented in the set. Physical size comparisons revealed a normal size congruity effect for comparisons of infinity and single-digit numbers. In contrast, a reversed size congruity effect emerged for comparisons of infinity and multi-digit numbers, suggesting that under conditions of automatic processing the infinity symbol was perceived smaller than large numbers. The findings suggest that the infinity symbol is not processed as numerical infinity. In addition, automatic processing of large numbers seems to be highly affected by the decimal syntactic structure. The implications of these results on the mental representation of numbers will be discussed.

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.. 17:55 – 18:15 (93) ..

**Integrating Indian and European naming systems for large numbers. DAVID LANDY & MITALI NAG; *Indiana University, United States of America***

People have robust systems for estimating and processing small numbers—those under about 1000. Unlike other animals, we also have notational systems that help us cope with very large numbers—notation systems that underlie much of modern physics, chemistry, economics, geology, and other

scientific fields, and are foundational to the existence and operation of large political systems. While small number systems have been extensively studied, the mechanisms by which we leverage notations to work with large magnitudes are largely unexplored. Here, we contribute to this literature by studying how a group of college-educated Indians living in India, who have training in both systems, place numbers on a line. The same magnitudes were presented in both the Western and Indian systems, allowing the examination of how the two systems interact. As with prior studies conducted in the US, a substantial fraction of the population made predictable and massive errors. Moreover, the errors persisted across representations. Despite intuitively finding translations from one system to another very difficult, participants showed very strong consistency in their placements across number systems. In particular, participants who showed errors in one system, showed commensurate errors in the other, indicating strong integration of the two systems at the level of strategy-informing beliefs. As in previous work, log-linear accounts fit data much less well than accounts that assumed responses were driven by notation. However, only weak evidence was found for notation-specific processing. Overall, results indicate that participants using multiple notation systems for large numbers form intuitions about number magnitude that reflect mutual information from both systems, and are based on a common set of prior assumptions about how numeral notations are likely to be constructed. Interestingly, these errors were more extreme in a group of graduate students and undergraduates than in adult businessmen and businesswomen with international business activity.

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## Symposium: How Aging Affects Language Processing: Lexical Access and Grammatical Computation

### H2, Monday, 16:35 – 18:15

.. 16:35 – 16:55 (94) ..

**Why do we have problems findings words when we get older and how can we improve it? MARCUS MEINZER; *The University of Queensland, Australia***

Due to the rapid growth of the elderly population, the incidence of age-associated cognitive impairment will substantially increase over the next few decades, imposing major economic, social, and medical burdens on societies worldwide.

Therefore, it is of utmost importance to improve our understanding of the neural mechanisms underlying these symptoms.

The language domain is particularly well suited to enhance our understanding of age-associated changes in brain function and performance, because it allows investigating (a) processes that show substantial decline across the lifespan, and also (b) how the aging brain can effectively compensate for structural and neurofunctional impairment. Improving knowledge about how the neural processes supporting language change in advanced age is also highly relevant to foster a better understanding of language impairment after neurological injury and in degenerative diseases, because this is the baseline from which older patients with these conditions depart.

In this talk, I will initially discuss functional imaging studies that compared the neural mechanisms underlying word-retrieval in healthy young and older adults. These studies will illustrate (a) substantial differences in brain processing at the local and functional network level between age groups but also (b) substantial variability in performance and brain organization within groups of older participants. Specifically, there is a subgroup of older individuals that exhibits similar performance and brain organization as their younger counterparts. Subsequently, I will discuss if age-associated changes in brain function and performance impairments can be reversed by non-invasive brain stimulation and identify behavioural and neural predictors of stimulation response in advanced age.

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.. 16:55 – 17:15 (95) ..

**Exposure and distributional characteristics explain the effects of age on vocabulary size and discrimination speed.** EMMANUEL KEULEERS<sup>1</sup>, PAWEŁ MANDERA<sup>2</sup> & MARC BRYBAERT<sup>2</sup>; <sup>1</sup>Tilburg University, The Netherlands; <sup>2</sup>Ghent University, Belgium

In this talk, we re-evaluate the effects of age on vocabulary size and word/nonword discrimination speed by presenting novel analyses of two large crowdsourced vocabulary tests in Dutch and English. One of the advantages of these crowdsourcing studies is that they reach a very diverse population in terms of age. As such, they allow us to evaluate the effects of age over a continuous range instead of only comparing younger and older groups. Regarding vocabulary size, this allowed us to show that vocabulary growth is logarithmic over the age period for which we had reliable data (from 12 to 72 years old). Vocabulary growth follows a trajectory similar to Herdan's law, which was formulated to account for vocabulary growth in text corpora (Herdan, 1960). With regard to re-

action time, we cast doubt on the long standing belief (Murray & Forster, 2004) that the power function is not a good candidate for describing the word frequency effect because older participants show a larger frequency effect than younger participants. On the contrary, we find that differences in the frequency effect over age can be predicted by a practice effect that is described by a power function if one takes into account the extreme distribution of word frequencies and the underspecification of frequencies in the low frequency range.

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.. 17:15 – 17:35 (96) ..

**Learning, memory and (mis)information: The artifactual nature of "healthy cognitive decline".** MICHAEL RAMSCAR; Eberhard Karls Universität Tübingen, Germany

As adults age, their performance on a range of psychometric tests declines. This has been taken to show that cognitive information-processing capacities also decline with age. I will present a series of analyses and experiments that all point to a different conclusion: that the patterns of slowing / "forgetting" – and non-slowing / "non-forgetting" – seen in healthy adults simply reflect the consequences of continual learning from the statistical distributions that typify much of human experience. I will then show how erroneous beliefs about cognitive decline are perpetuated by the flawed measures currently used to measure cognitive performance: Using simulations based on large data samples, I'll show how the patterns of test performance usually labeled as "decline" emerge in standard learning models as the range of knowledge that they acquire increases. The simulations correctly predict greater variation in the cognitive performance of older adults, that older adults will exhibit much greater sensitivity to fine-grained differences in the properties of test items than younger adults, as well as identifying circumstances in which age effects can be negated or even reversed. I'll also discuss a global model of cognitive function in which many of the changes in grey and white matter that are currently misinterpreted as "neural atrophy" can be seen as adaptations that serve to regulate the behavioral and metabolic requirements of mature brains.

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.. 17:35 – 17:55 (97) ..

**The statistical probabilities of learning a new language in the elderly.** JON ANDONI DUNABETIA<sup>1</sup> & AINA CASAPONSA<sup>2</sup>; <sup>1</sup>Basque Center on Cognition, Brain and Language, Spain; <sup>2</sup>Lancaster University, UK

Learning a new language is not an easy duty, especially for older adults. Several factors inter-

act to make language acquisition so complicated for older adults, including the age-related non-pathological cognitive decline that may alter the mechanisms related to language monitoring and control, and some encoding problems associated with the hyper-binding phenomenon. According to some theoretical and experimental proposals, older adults have severe difficulties with the extraction of the statistical regularities from the context, and this can ultimately alter their language perception, production and acquisition system, making learning a new language late in life a difficult endeavor. In the current study we longitudinally studied a group of older adults who were acquiring a new language late in life. We explored the degree of sensitivity to the statistical regularities of the new language and to those of the native one, and how these changed over the course of language learning. In a series of experiments testing orthographic markedness effects, the results showed severe difficulties in accessing the statistical regularities of the new language, while at the same time they demonstrated that some specific pieces of orthotactic information are effectively processed and used as language cues in the elderly.

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.. 17:55 – 18:15 (98) ..

**Grammatical computation versus lexical look-up: selective aging effects in language processing.** JANA REIFEGERSTE<sup>1</sup> & KRISTIN PREHN<sup>2</sup>; <sup>1</sup>*University of Potsdam, Germany*; <sup>2</sup>*Charité Berlin, Germany*

Over the last century, the average human lifespan has more than doubled, rendering the effects of aging on cognition, including language, a vital research topic. Yet the study of the developmental trajectory of language processing has largely focused on comparing linguistic abilities between children and young adults, and has for the most part ignored changes during aging, calling for more research on language processing in this ever-growing group of people. Examining changes in language processing during aging, and what underlies those changes, may further open windows into the cognitive and neural underpinnings of language more generally.

In this talk introducing the symposium on the study of language in aging, we will provide an overview of the effects of aging on language, focusing on the processing of simple words (lexical processing) and their combination into more complex words, phrases, and sentences (grammatical processing). We will lay out the interplay of age-related changes to cognition – that is, declines in perception, speed, memory, and executive functioning on the one hand and increases in knowledge and experience on the other –, and how these changes may affect how speakers process language.

The emerging picture shows strong effects of aging on lexical processing, such as increased word-finding difficulties despite (or possibly because of?) greater vocabularies in older people. Grammar, however, shows a more complex picture; it appears that syntactic processing as well as the processing of regular morphology can be preserved in aging, except when it depends importantly on other cognitive functions that themselves are affected by aging.

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## Symposium: Mechanisms of Forgetting in Working Memory H5, Monday, 16:35 – 18:15

.. 16:35 – 16:55 (99) ..

**What is the Meaning of Memory Decay?** NELSON COWAN; *University of Missouri, United States of America*

In particle physics, radioactive decay is the result of the stochastic, sudden death of particles that is seen on a population level as a gradual, smooth diminishing of radioactivity. The view I have taken is that the decay of information from working memory may be similar, with chunks as the particles. The temporary activation of each chunk can undergo sudden death and the result is what we see as the gradual loss of memory for an ensemble of chunks. Some processing factors can make the loss less likely, resulting in a slower rate of decay. I will argue for this view with reference to classic work on short-term memory and our own examination of the question throughout the past 20 or so years of behavioral and electrophysiological research.

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.. 16:55 – 17:15 (100) ..

**Forgetting and the mechanisms that counteract forgetting in working memory.** EVIE VERGAUWE<sup>1</sup> & TIMOTHY RICKER<sup>2</sup>; <sup>1</sup>*University of Geneva, Switzerland*; <sup>2</sup>*City University of New York, USA*

According to temporal decay accounts of working memory, to-be-remembered information is lost from working memory because it decays over time. Attention-based post-encoding processes are often invoked by decay models to explain the absence of forgetting over time, proposing that attention-demanding post-encoding processes can counteract the effects of decay. Here, we will (1) argue

that decay and other causes of forgetting (e.g., interference) are not necessarily mutually exclusive, (2) demonstrate that, although the evidence for decay is not abundant, there are some clear, replicable data patterns that are difficult to account for without assuming temporal decay (both in verbal and visuo-spatial working memory), and (3) demonstrate the need to advance our understanding of the attention-demanding post-encoding processes that are assumed to counteract the effects of decay, with illustrations for the processes of attentional consolidation and attentional refreshing.

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.. 17:15 – 17:35 (101) ..

**Forgetting of spatial WM over time: Evidence for decay?** KLAUS OBERAUER & ALESSANDRA SOUZA; *University of Zurich, Switzerland*

Accuracy of spatial working memory has been found to decline, remain stable, or even improve over time, depending on the experimental procedure. Lilienthal, Hale, and Myerson (2014; M&C) found that memory for a list of spatial locations in an irregular grid improved over time when the grid was visible throughout the retention interval but declined over time when the grid was invisible. They interpreted their results as reflecting time-based decay, which is (over-) compensated by rehearsal in the presence of the grid. We replicated the basic finding of Lilienthal et al. with sequential presentation of 5 spatial locations, followed by a test of all locations in random order. Longer inter-stimulus-intervals (ISIs), implying a longer retention interval, resulted in worse memory only when the grid was invisible during the ISIs. The serial position curves in all conditions showed the typical U-shape, with about equal primacy and recency. Serial position did not interact with grid condition or retention interval. The serial-position effects pose a challenge to a decay explanation: Decay affects earlier list items more than later ones. To compensate this effect, and even generate a primacy effect, rehearsal must be strongly concentrated on early list items. Allocating rehearsal across list positions such that forgetting affects all list positions equally requires a fine-tuned balancing act. We tried to fit the data with several models implementing decay and rehearsal, with highly flexible assumptions about how rehearsal time is allocated to serial positions, and found that the models had difficulties accommodating the additive effects of serial position with condition and retention interval. Although on an aggregate level the data appear to be strong evidence for decay, the detailed pattern of forgetting over serial positions is difficult to explain with a decay model even with liberal assumptions about rehearsal.

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.. 17:35 – 17:55 (102) ..

**Forgetting in working memory caused by internally-generated interference.** ALEXANDER SOEMER; *Uni Potsdam, Germany*

Although the working memory construct has inspired a great deal of scientific research in psychology and related fields, many controversies and disagreements still exist. Object of an extraordinarily active debate in this regard is the question of what causes forgetting in working memory. One traditional explanation states that forgetting is the result of mutual interference between working memory representations. This interference explanation has been primarily applied to forgetting of verbal material over filled retention intervals (RIs), that is, RIs during which participants have to perform a secondary task between presentation and test of the to-be-remembered verbal material. However, a challenge for interference accounts is to explain why some types of material (e.g., sounds differing in timbre or visual symbols) are sometimes forgotten in the absence of any secondary task, and why forgetting in such unfilled RIs is sometimes a function of RI length. The present talk discusses the possibility that forgetting in unfilled RIs is partly the result of internally-generated interference, that is, interference caused by internally-cued processes. The basic idea is that participants experience (voluntarily or involuntarily initiated) task-unrelated thoughts (TUTs) during the unfilled RI. These TUTs represent the activation of long-term memory representations which become contents of working memory and thereby cause interference on the to-be-remembered material. Experiments are reported that sought to test a number of predictions derived from this idea. The results suggest that internally-generated interference, indeed, plays an important role with regard to forgetting over unfilled RIs. However, it is also discussed to what extent the notion of internally-generated interference may, in fact, be consistent with the alternative decay accounts of forgetting.

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.. 17:55 – 18:15 (103) ..

**Directing attention to reduce forgetting in working memory.** RICHARD ALLEN; *University of Leeds, United Kingdom*

Items held in visual working memory (VWM) are easily lost, particularly when further stimuli are subsequently encountered. The likelihood of an item being forgotten can be reduced by directing attention to it, though this often results in increased forgetting for other items in the sequence. This series of experiments explored how attentional direction as manipulated by the relative importance and relevance of items in a VWM task determines successful recall vs. forgetting. Drawing on prior-

itization and interference manipulations, and studies with young adults and children, we find evidence for both controlled and automatic impacts on performance. These results indicate how different factors influence whether an item is retained in the focus of attention, and that this largely determines whether information is preserved or forgotten in VWM tasks.

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## Symposium: Contingency Learning, Binding, and Their Interrelations

### H6, Monday, 16:35 – 18:15

.. 16:35 – 16:55 (104) ..

**Are contingency learning and binding one and the same?** JAMES R. SCHMIDT<sup>1</sup>, JAN DE HOUWER<sup>1</sup> & KLAUS ROTHERMUND<sup>2</sup>; <sup>1</sup>*Ghent University, Belgium*; <sup>2</sup>*Friedrich-Schiller-Universität Jena, Germany*

In order to navigate our world successfully, it is necessary to be able to learn the contingent regularities between events, and a rich literature on human contingency learning investigates how we learn these regularities. For instance, if a stimulus (e.g., word) is presented most often before a given response (e.g., keypress), then we quickly learn this contingency and begin responding faster and more accurately when the stimulus is followed by the expected response rather than with an unexpected response (e.g., a different keypress). In parallel, another literature has focused on how different stimulus and response events are bound together in memory, and how recently-encoded bindings influence behaviour. For instance, if a given stimulus was just presented along with a given response, then presenting the same stimulus again will facilitate a repeated response, but impair a different response. In the limited research that has directly compared learning and binding procedures, it has often been assumed that the memory processes underlying learning and binding effects are fundamentally different. For instance, it has been proposed that stimuli and responses are bound together in temporary short-term memory traces, which produce binding effects, but these traces are said to quickly disintegrate. In contrast, contingency learning effects have been argued to be produced by memories of regularities that have been discovered and which are stored in long-term memory. In contrast, this talk will present simulations with the Parallel Episodic Processing (PEP)

model, which demonstrate that binding and contingency learning effects can be coherently explained by a single episodic memory store. In this view, binding and contingency learning effects are regarded as merely short- and long-term manifestations of the exact same memory encoding and retrieval processes.

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.. 16:55 – 17:15 (105) ..

**Are stimulus-response binding and retrieval effects immune to manipulations of S-R contingencies?** CARINA GIESEN & KLAUS ROTHERMUND; *FSU Jena, Germany*

Stimuli and simultaneously executed responses are integrated into a transient episodic structure (an S-R binding or event file); repeating the stimulus triggers retrieval of the associated response. To examine whether retrieval of S-R bindings is sensitive to contextual influences, we manipulated contingencies between stimulus repetitions and response repetitions across three blocks (Exp 1). Stimulus repetitions were either predictive of response repetitions (positive contingency) or response changes (negative contingency) or orthogonal to the response relation (no contingency). Results revealed that compared to the orthogonal condition, S-R binding and retrieval effects were boosted under positive contingency but were reduced under negative contingency, although participants were unaware of the contingency manipulation. Findings from Experiment 1 implicate that S-R binding and retrieval processes may be implicitly tuned to adapt to contextual manipulations that either promote or hinder the use of S-R bindings for automatic action regulation. Three additional experiments tested whether participants implicitly adapt to context-specific cues for (positive or negative) S-R contingencies on a trial-to-trial basis. Positive or negative contingencies for a trial sequence were cued by contextual features (Exp 2: stimulus location; Exp 3 and 4: frame color). Participants were either unaware of the contingencies (Exp 2 and 3) or explicitly instructed and trained to use contextual cues (Exp 4). Context-specific modulations of S-R binding and retrieval effects were absent in Experiments 2 and 3, but present in Experiment 4, which attests to limits in implicit detection and utilization of context-specific S-R contingencies.

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.. 17:15 – 17:35 (106) ..

**Overlearned responses hinder S-R binding.** BIRTE MOELLER & CHRISTIAN FRINGS; *Trier University, Germany*

Two mechanisms that are important for human action control are the integration of individual ac-

tion plans (see Hommel, Müsseler, Aschersleben, & Prinz, 2001) and the automatization of overlearned actions to familiar stimuli (see Logan, 1988). Here we analyzed the influence of automatization on action plan integration. Integration with pronunciation responses were compared for response incompatible word- and non-word stimuli. Stimulus-response binding effects were observed for non-words. In contrast, words that automatically triggered an overlearned pronunciation response were not integrated with pronunciation of a different word. That is, automatized response retrieval hindered binding effects regarding the retrieving stimulus and a new response. The results are a first indication of the way, how binding and learning processes interact.

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.. 17:35 – 17:55 (107) ..

**Doing is for Feeling.** KATARINA BLASK, EVA WALTHER & CHRISTIAN FRINGS; *University of Trier, Germany*

In two experiments we show that preferences can be formed by transfer of valence from an unconditioned stimulus (US) to an action and then from this valence-laden action to a novel conditioned stimulus (CS) even though the US and CS were never presented together. This result expands the approach of intersecting regularities (Hughes, De Houwer, & Perugini, 2016) to yet another realm of evaluative learning. In addition, our approach to evaluative learning suggests theoretical links between the formation of preferences due to actions and general research on action control. In summary, we discovered an additional route via which humans may acquire novel preferences and we propose a mental mechanism that may play an important role in the perceptuomotor system that controls many daily life behaviors.

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## Symposium: Cognition at the Brink of Failure: The Multiple Facets of Auditory Distraction

### H7, Monday, 16:35 – 18:15

.. 16:35 – 16:55 (108) ..

**Auditory distraction during short-term remembering: A duplex-mechanism account.** ROBERT WYN HUGHES; *Royal Holloway, University of London, United Kingdom*

Background

This talk will provide an overview of a duplex-mechanism account of auditory distraction—developed on the basis of distraction effects produced during short-term memory tasks—supported by reference to both published and as-yet-unpublished studies. In this account, auditory distraction is divided into two main types: Interference-by-process (Type I) occurs when the processing of the sound conflicts specifically with similar processes involved in the focal task while the second type encompasses any distraction effect that is due to attentional diversion or capture, a more general, task-process non-specific, form of distraction (Type II).

#### Method

The impact of continuously changing-state sound on serial recall will be used as the main phenomenon exemplifying interference-by-process. A range of distraction phenomena—including the distracting effect of unexpected deviant sounds, post-categorical (e.g., word valence) distraction effects, and those from complex linguistic sequences, will be discussed as examples of the more general, attentional diversion-driven, type.

#### Results

I will give an overview of a set of results supporting a functional dissociation between the two types of distraction, focusing in particular on their differential amenability to top-down cognitive control—including countering some recent challenges to this assumption—and their differential task-process specificity.

#### Discussion

Given that interference-by-process and attentional diversion can co-occur, it is important to consider including empirical tests designed to isolate their respective contributions to any auditory distraction effect.

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.. 16:55 – 17:15 (109) ..

**Do deviant sounds induce action plan uncertainty? A new take on deviance distraction.** FABRICE PARMENTIER; *University of the Balearic Islands, Spain*

Rare and unexpected changes in an otherwise repetitive sequence of task-irrelevant sounds (deviant vs. standard sounds) ineluctably break through attentional filters and yield longer response times in an ongoing task (deviance distraction). Recent findings suggested that deviance distraction is absent when sounds do not fulfill the function of unspecific warning signals. Here I challenge this contention and demonstrate that this apparent absence of deviance distraction results from two opposite effects: Deviance distraction when the previous trial involved a target and required responding, and facilitation by deviant sounds following trials involving no target and requiring the withholding of

responses. Data from a new experiment, new analyses of the data from three earlier studies, and the modelling of these data, all converge in suggesting that deviant sounds, by modifying the task context, hinder the use of the currently activated action plan while facilitating the selection of an alternative plan.

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.. 17:15 – 17:35 (110) ..

**Too interesting to ignore! - Effects of novel sound processing on the pupil diameter and task performance in children.** NICOLE WETZEL<sup>1,2</sup> & ANDREAS WIDMANN<sup>3</sup>; <sup>1</sup>*Neurocognitive Development Lab, Leibniz Institute for Neurobiology, Magdeburg, Germany;* <sup>2</sup>*Center for Behavioral Brain Sciences, Magdeburg, Germany;* <sup>3</sup>*Cognitive and Biological Psychology, Institute of Psychology, University of Leipzig, Leipzig, Germany*

The control of attention is an important part of our executive functions and enables us to focus on relevant information and to ignore irrelevant information. The ability to shield against distraction by task-irrelevant sounds was suggested to mature during school age.

In three studies, we systematically investigated effects of distraction by unexpected task-irrelevant sounds on performance in a visual task in children aged 4 to 10 years. Distractor sounds were rarely and randomly interspersed between standard sounds. Moreover, we compared effects of novelty, meaning, and complexity of distractor sounds on performance in different age groups. Distractor sounds increased reaction times in the visual task compared to standard sounds. This distraction effect decreased with age, indicating increasing control of attention during childhood. In particular, the novelty of distractor sounds affects performance.

In a fourth study we focused on the impact of distractor sounds on the pupil size as a marker of auditory involuntary attention in infants. We presented an oddball paradigm including four types of deviant sounds (noise, baby cry, phone ring, pitch deviant) within a sequence of repeated standard sounds to 14-month-old infants and to adults. Environmental and noise deviant sounds elicited a strong biphasic pupil dilation response (PDR) in both age groups. A principal component analysis revealed two components that reflect the parasympathetic inhibition and sympathetic activation of the muscles controlling the pupil. The component scores differ, depending on distractor types, between age groups. High arousing distractor sounds elicited an increase of the sympathetic component, that is known to reflect emotional arousal, in children compared to adults. This indicates higher sensitivity to emotionally arousing distractor sounds in infants. Results demonstrate

that the PDR is a sensitive tool for the investigation of involuntary attention mechanisms in preverbal children.

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.. 17:35 – 17:55 (111) ..

**The complex demands on attention and working memory of intensive care: When alarms turn into distracters and distracters turn out to be alarms.** KATHRIN LANGE; *Federal Institute for Drugs and Medical Devices, Germany*

„Cognitive processes are vulnerable to changes in sensory input, even if the sensory input is irrelevant for the task at hand and could be ignored“. It is safe to say that this holds for applied settings, as well, for instance for the tasks performed on an intensive care unit (ICU). However, whereas the relevance of the sensory input and the task-at-hand may be unequivocally defined for the laboratory, a clear cut distinction is not always possible for applied contexts. For instance, an intensive care nurse may prepare a particular dosage of a particular drug and - at the same time - receive auditory input from a physiological monitor, a ventilator and a couple of infusion and syringe pumps. This auditory input is intended to inform the nurse about both the vital status of the patient and the functioning of the many life-supporting and life-sustaining devices and alarm the nurse in case of life threatening conditions - such as an excessively high heart rate or the disconnection of a breathing tube. Hence, the nurse has to allocate a certain amount of their attention to the auditory input - which should increase the distracting effect of this input on the other task. Because, however, errors in the other tasks may have fatal consequences, as well, the nurse is required to carefully distribute their processing resources across tasks in order to ensure patient safety. In my talk, I will discuss several characteristics of the work on an intensive care unit that may influence the distribution of processing resources. My aim is to provide some insight into this specific work domain in order to stimulate future laboratory studies to address, for instance, the mutual distracting effect of monitoring alarms and performing different other tasks.

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.. 17:55 – 18:15 (112) ..

**Is auditory distraction modulated by anxiety: An application of the Attentional Control Theory to deviance distraction.** STEFAN BERTI; *Johannes Gutenberg University Mainz, Germany*

The Attentional Control Theory (Eysenck et al., 2007) assumes that trait anxiety modulates the efficacy of attentional orientation to task relevant information and that persons with high trait anxiety

ety are more prone to distraction by sensory events compared with persons with low trait anxiety. In the present study, this assumption was tested within two sensory distraction paradigms which depict the effect of task irrelevant changes in the sensory input on task performance. Forty-three participants performed two tasks: an auditory and a visual classification task. In both tasks, rare and unpredictable changes are embedded in the relevant auditory stimulation (auditory-auditory distraction paradigm) or in a parallel but irrelevant auditory stimulation (auditory-visual distraction paradigm) to test to what extent task performance is impaired by these irrelevant changes. As a measure for distraction the difference of response times in trials with the sensory change compared to the standard trials is calculated. In addition, after each block participants reported also how much effort they invested in order to perform the classification tasks. Linear regressions of the individual trait anxiety (determined with the German version of the State-Trait-Anxiety Inventory) and the dependent variables depict no substantial correlation between performance and anxiety in these tasks. However, participants with higher trait anxiety scores tend to invest higher effort into performing the visual task. This pattern of results partly supports the assumption of the Attentional Control Theory because this theory suggests that persons with higher trait anxiety can compensate for less efficient attentional control by enhancing the effort in performing a task. In contrast, there is no direct correlation between anxiety and distraction, which questions the assumed effect of anxiety on openness for bottom-up mechanisms assumed by the Attentional Control Theory.

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## Symposium: Spatial Cognition and Navigation H8, Monday, 16:35 – 18:15

.. 16:35 – 16:55 (113) ..

**What can eye-tracking tell us about the cognitive mechanisms underlying successful navigation?** JAN MALTE WIENER, RAMONA GRZESCHIK & CHRISTOPHER HILTON; *Bournemouth University, United Kingdom*

In this talk we will present a series of experiments in which we used of eye-tracking and virtual environments technology to investigate cognitive mechanisms underlying navigation behaviour. In some experiments we systematically manipulated the spatial task while keeping environ-

mental features constant. Results from these experiments highlight an interesting mix of task-driven and environment-driven influences on gaze behaviour during navigation. More recently, we have used eye-tracking to investigate whether differences in the control of visual attention may contribute to age-related differences in navigation behaviour. While we found strong performance differences between age-groups in different navigation tasks, gaze behaviour was surprisingly similar between age-groups. Together, the results from our studies suggest that the analysis of gaze behaviour is a promising mean to develop a better understanding of how navigators solve different navigation tasks, but may be less suited to investigate individual difference in navigation performance.

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.. 16:55 – 17:15 (114) ..

**Which way am I facing - mechanisms of orientation coding in the human brain.** THOMAS WOLBERS; *German Center for Neurodegenerative Diseases (DZNE), Germany*

Spatial navigation - one of the most fundamental behaviors in humans and other animals - involves a multitude of cognitive functions and processes. One key component is how we keep track of our facing direction relative to the environment. In rodents, head direction (HD) cells code orientation information by firing when the animal assumes a particular facing direction. These cells have been identified in a distributed network of subcortical and cortical regions, and they are known to compute HD from multiple sensory modalities and in multiple spatial references frames.

In this talk, I will present a series of experiments that have begun to characterise the HD system in the human brain. Using interactive virtual reality and high resolution fMRI, these studies have provided evidence for HD coding in the thalamus and retrosplenial cortex, two structures in which HD cells are abundant in rodents. Importantly, their recruitment depends on the sensory information that is used to compute facing direction, suggesting that the thalamus, in particular, is sensitive to body based cues. Moreover, I will present evidence for different spatial reference frames to be encoded in the HD system. Critically, depending on the task at hand, the human HD system can use global reference frame cues to integrate facing direction across separate individual locales, an important requirement for the formation of cognitive maps. Together, these studies also demonstrate how immersive training procedures that harness the potential of advanced virtual reality technology can help to elucidate the neural mechanisms supporting human spatial navigation.

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.. 17:15 – 17:35 (115) ..

**Sensorimotor effects in spatial perspective taking.** MARIOS AVRAAMIDES; *University of Cyprus, Cyprus*

A common finding in spatial perspective taking is that performance suffers as the angular disparity between the observer's actual and imagined perspectives becomes larger. This effect could be attributed to mental transformation processes required to align the two perspectives in imagery or to sensorimotor conflicts exerted by the observer's body position and orientation in space. In this talk, I will present findings from a series of experiment carried out in my lab, aiming to understand the source of the difficulty in perspective taking. In these experiments participants viewed a spatial scene that consisted of a table with a number of empty seats around it. In each trial they were asked to imagine themselves sitting at one of the seats and point from that orientation to a virtual character that appeared sitting on another seat. Pointing error and the speed or responding were analyzed as a function of the angular disparity between participants' actual and imagined perspectives. Several conditions were ran to examine factors that may influence the size of the angular disparity effect.

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.. 17:35 – 17:55 (116) ..

**Neural activity underlying imagined and physical heading changes in humans.** KLAUS GRAMANN; *TU Berlin, Germany*

Spatial orientation is a complex task that is based on several sensory modalities when humans actively navigate in their natural environment. Decades of brain imaging studies have investigated the neural architecture underlying spatial orientation providing an increasingly precise picture of the cortical networks involved in spatial orientation. Thus, "traditional" brain imaging studies like functional magnetic resonance imaging (fMRI) largely neglect important aspects inherent to natural spatial cognition, i.e. the central role of movement-related sensory information (i.e., idiothetic information). Movement and the associated idiothetic information are not investigated in imaging studies to avoid movement-related artifacts from distorting the signals of interest (Makeig et al., 2009). As a consequence, the cortical activation patterns accompanying naturally occurring sensory and cognitive processes during active spatial orientation and how these contribute to spatial representations are largely unknown (Gramann, 2013).

To overcome these problems and to gain new insights into the neural basis of natural spatial cognition Mobile Brain/Body Imaging (MoBI) approaches can be used, combining recording of human brain dynamics with motion capture to record and analyze brain dynamics accompany-

ing movement-related idiothetic information processing. I will present a MoBI study investigating the representation and use of proprioception and vestibular information during active as compared to visual flow heading changes. Using independent component analyses on high-density EEG data synchronized to motion capture and head mounted virtual reality reveals frequency modulations in distinct cortical regions reflecting vestibular information processing. The results will be discussed including problems of the methods and future avenues to better understand embodied brain dynamics accompanying natural spatial cognition.

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.. 17:55 – 18:15 (117) ..

**Social and configural effects on the cognitive dynamics of perspective-taking.** ALEXIA GALATI<sup>1,2</sup>, NICHOLAS D. DURAN<sup>3</sup> & RICK DALE<sup>1</sup>; <sup>1</sup>*University of California Merced, United States of America*; <sup>2</sup>*University of Cyprus, Cyprus*; <sup>3</sup>*Arizona State University, United States of America*

In spatial reasoning, different factors have been shown individually to influence perspective selection, including the egocentric viewpoint, the conversational partner's viewpoint, and the orientation of the spatial configuration. Although prior work has examined the joint contribution of social and configural factors to the maintenance of spatial information in memory (e.g., Galati & Avraamides, 2015), little is known about how these cues are integrated in processing. We examine how the convergence of a configural cue (the orientation of a configuration of objects) with social cues (the egocentric and other-centric perspectives) influences perspective selection during language interpretation.

In a task adapted from Duran, Dale, and Kreuz (2011), 200 listeners received instructions from a simulated partner, whose position was depicted around a round table (at 0°, 90°, 180°, or 270°), to select an object (e.g., "Give me the folder on the left"). The objects on the table formed triangular configurations that were aligned with the listeners' perspective at 0° (ego-aligned), the partner's perspective (other-aligned), or neither perspective (neither-aligned). Based on their distribution of responses on ambiguous trials, on which the instruction could be interpreted either from an egocentric or other-centric perspective, listeners were classified as egocentric, other-centric, or mixed responders.

Overall, other-centric responders were slower than egocentric responders, making longer mouse-trajectories with more directional shifts. Despite the cognitive demands of responding other-centrally, indicated by these more complex trajectories, most responders (70%) opted for that perspective. Importantly, only other-centric responders were sens-

itive to the configural cue: they were slower on neither-aligned configurations (vs. ego-aligned), making more directional shifts, and were also marginally faster on other-aligned configurations.

These findings suggest that adopting another's perspective increases sensitivity to other cues, such that the convergence of social and configural cues can impact the dynamics of perspective-selection. In contrast, when being egocentric, these cues can be ignored.

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## Numerical Cognition I H1, Tuesday, 09:00 – 10:40

.. 09:00 – 09:20 (118) ..

**The Influence of Gain and Loss on Arithmetic Performance.** RAM NAAMAN & LIAT GOLDFARB; *University of Haifa, Israel*

The emotional modulation of cognition has long been studied under different conditions. Specifically, gain and loss emotional stimuli seem to have an opposite effect on different aspects of executive functions (EF). Nevertheless, the nature of this effect is not entirely clear, and both gain and loss were found to improve performance in specific EF tasks, while hindering performance in others. Since arithmetic processes have been found to rely heavily on EF, the current study addresses the question of "whether" and "how" gain and loss stimuli might affect arithmetic performance. To examine this question, 3 experiments were conducted. In Experiment 1, an arithmetic equation judgment task with either carry or non-carry equations representing different complexity levels was used. Each trial began with a line drawn face representing either monetary gain (i.e., happy face), loss (i.e., sad face), or no monetary meaning (i.e., neutral face). In Experiment 2, the different levels of arithmetic complexity were represented by two and three addend equations, and in Experiment 3, the proportions of correct and incorrect equations were modulated. Results from all experiments demonstrate improved performance, reflected by reduced RT in the arithmetic task after gain stimuli when compared to loss stimuli. Our results further extend our understanding regarding the nature of the relationship between gain and loss stimuli and cognitive performance and specifically suggest how arithmetic performance can be improved.

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.. 09:20 – 09:40 (119) ..

**Electrophysiological Basis of Simple Additions.** GLORIA TEJERO<sup>1,2</sup> & PEDRO MACIZO<sup>1,2</sup>; <sup>1</sup>*University of Granada, Spain*; <sup>2</sup>*Mind, Brain and Behavior Research Center (CIMCYC, Spain)*

It was widely assumed in the past that simple additions were solved by retrieving their answer from memory (e.g., Campbell, 1995). At present, this account is accepted for tie addition problems (e.g.,  $2 + 2 = 4$ ). However, recent evidence suggests that adults use fast counting procedures to solve non-tie additions, especially when they involve one-digit operands from 1 to 4 (Uittenhove, Thevenot, & Barrouillet, 2012). In our study, we aimed at evaluating cognitive processes underlying the resolution of simple additions based on electrophysiological evidence. Thirty adults solved one-digit additions while brain-waves were recorded. We considered an event-related brain potential (ERP) index associated to successful retrieval of information from associative memory (a broad sustained positive wave between 300 and 800 ms) (Donaldson & Rugg, 1999). Overall, when several types of addition problems were compared, the same electrophysiological pattern was observed in early ERP components. However, differences emerged between addition problems in late time-windows: Non-tie problems showed more positive waves than tie-problems; small problems (i.e., with sums  $> 10$ ) were associated to this sustained positivity compared to very small additions (i.e., with sums  $< 10$ ). These ERP modulations across types of additions closely resemble those found in associative tasks depending on the strength of the connections of information stored in memory. Together, the results found in our study suggest that one-digit additions are solved by retrieving the solution from associative memory.

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.. 09:40 – 10:00 (120) ..

**Representation of Numerical Magnitude in Math-anxious Individuals.** ANGELS COLOME GONZALEZ; <sup>1</sup>*University of Barcelona -Faculty of Psychology, Section of Cognitive Processes, Spain*; <sup>2</sup>*Institute of Neurosciences, University of Barcelona, Spain*

Background: Two studies (Maloney et al., 2011; Núñez-Peña et al., 2014) have recently suggested that high math-anxious (HMA) individuals might have a deficient representation of numerical magnitude. Both studies used symbolic comparison. In contrast, a recent work by Dietrich et al. (2015) has shown a lack of math anxiety effects in non-symbolic comparison. Furthermore, whether distance effects in symbolic comparison reflect the properties of the magnitude representation or decisional processes is currently under debate. Our study aimed at replicating the findings obtained

with non-symbolic magnitudes. It also tested the effects of math anxiety in the representation of magnitudes through three different symbolic tasks.

**Method:** In the first study, two extreme groups of 26 HMA and 26 low-math anxious (LMA) individuals were formed according to their scores in the Shortened Mathematics Anxiety Rating Scale (sMARS). Participants performed a dot comparison, an Arabic digits comparison and a counting Stroop task. In the second study 60 participants answered the sMARS and performed a same-different task.

**Results:** There was a ratio effect and an effect of perceptual congruency in the non-symbolic task. In contrast, there were no effects of math anxiety in either latencies, error rates, or W fractions. As for the symbolic tasks, distance, size and congruency effects were obtained. However, math anxiety did not interact with any of them. The same-different task in study 2 revealed a distance effect, which did not correlate with math-anxiety scores.

**Discussion:** This study presents the results of a non-symbolic and three symbolic tasks assessing the acuity of the internal numerical representation. Despite replicating the effects considered to indicate access to the magnitude representation, we failed to obtain any significant effect of math anxiety. Therefore, the hypothesis of a less precise magnitude representation in HMA individuals is not supported by any of our four experiments.

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.. 10:00 – 10:20 (121) ..

### **Unravelling the impact of ANS and executive functions on mathematics achievement.**

ILSE {ELISE JOHANNA INGRID} COOLEN, JULIE CASTRONOVO, KEVIN RIGGS & MYFANWY BULLER; *University of Hull, United Kingdom*

#### **Background**

The ability to represent approximate numerical magnitudes is often referred to as approximate number system (ANS) and has regularly been proposed as foundational to mathematics achievement. Additionally to correlational studies, longitudinal research suggested ANS acuity to be predictive of later mathematics achievement. Furthermore, compelling evidence came from studies training the ANS resulting in improved children's mathematics performance. However, currently some argue that the relation between ANS and mathematics is mediated by more general factors such as executive functions, claiming that controlling for executive functions reduces or eliminates the link between ANS and mathematics. This study looks at the relation between various ANS acuity measures as well as some executive functions and mathematics achievement.

#### **Method**

106 children aged 4 to 7 recruited from 3 primary schools in East Yorkshire were asked to take part in 2 computerised ANS tasks (Panamath and a non-symbolic addition task), 2 executive function tasks (Pathspan, measuring spatial working memory and the eyes task, measuring shifting skills and inhibitory control) and TEMA-3 as a measure for children's mathematics achievement.

#### **Results**

Preliminary results of hierarchical multiple regressions show that ANS is marginally predictive of mathematics after controlling for executive functions, only while using the Weber fraction as ANS acuity measure, however, the trend disappears when using accuracy of Panamath or the addition task. When executive function tasks are considered separately, Pathspan is a significant predictor of mathematics achievement, however, the eyes task seems not to be predictive in this model.

#### **Discussion**

This study emphasises variability in results when using different ANS acuity measure, hence, caution should be used when interpreting ANS studies. Spatial working memory seems to be an important predictor for mathematics achievement, while inhibitory control and shifting skills are less crucial in this model than described in previous research.

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## **Cognitive Control I H2, Tuesday, 09:00 – 10:40**

.. 09:00 – 09:20 (122) ..

### **How performance-contingent reward prospect modulates cognitive control: Enhanced usage and maintenance of non-predictive contextual cues.**

CARMEN HEFER & GESINE DREIBACH; *University of Regensburg, Germany*

Growing evidence suggests that performance-contingent reward promotes cognitive stability in terms of increased cue maintenance. In a recent study, Hefer and Dreibach (2017) showed that this typical reward effect comes at the cost of decreased flexibility. Subjects assigned to the reward group perseverated in using contextual cues even when their predictive value changed from highly predictive to non-predictive. The aim of the present study was to investigate whether performance-contingent reward also impairs the flexibility to adapt to changed task conditions when the predictive value of contextual cues changes from non-predictive to highly predictive. To this end a modified version of the AX-continuous performance task

was used. In this task, the cue A or B is followed by a probe X or Y resulting in AX, AY, BX, and BY trials. The letters B and Y are variables for any letter other than A or X. Only on AX trials, participants give a target response, otherwise a non-target response. In the AX-70 version, AX sequences occur with a frequency of 70%, the other sequences with 10% each. In the AX-40 version, the A-cue is followed by an X-probe and Y (variable)-probe with equal probability (AX-40%, AY-40%, BX-10%, BY-10%). Thus, in both versions the A-cue is predictive of the X-probe but only in the AX-70 version it is also predictive of the target-response. In two experiments the reward groups showed highly increased errors on AY trials already in the first AX-40 block. The results therefore are not suited to decide whether reward impairs the flexibility to adapt from non-predictive to predictive cues. Instead, they show that reward enhances the usage of contextual information even when it is not helpful because it does not predict required actions but only events.

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.. 09:20 – 09:40 (123) ..

**High body mass index is associated with impairments in reactive control during task switching.**

LAURA STEENBERGEN<sup>1,2</sup>, ROBERTA SEL-LARO<sup>1</sup> & LORENZA COLZATO<sup>1,3,4</sup>; <sup>1</sup>*Leiden University & Leiden institute for brain and cognition, Netherlands, The;* <sup>2</sup>*University of Amsterdam, the Netherlands;* <sup>3</sup>*Department of Cognitive Psychology, Institute of Cognitive Neuroscience, Ruhr University Bochum, Bochum, Germany;* <sup>4</sup>*Institute of Sports and Sport Science, University of Kassel, Kassel, Germany*

The prevalence of weight problems is increasing worldwide. There is growing evidence that high body mass index (BMI) is associated with frontal lobe dysfunction and deficits concerning cognitive control. The present study aims at extending these observations to cognitive flexibility, the ability to display efficient task-switching. Normal weight ( $BMI < 25$ ) and overweight ( $BMI \geq 25$ ) university students performed a task-switching paradigm that provides a relatively well-established diagnostic measure of proactive versus reactive control with regard to cognitive flexibility. Compared to normal BMI, high BMI was associated with increased switching costs in the reactive switching condition (i.e. short preparation time), representing reduced cognitive flexibility in the preparatory domain. The present findings are consistent with and extend previous literature showing that high BMI in young, otherwise healthy individuals is associated with less efficient cognitive control functioning.

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.. 09:40 – 10:00 (124) ..

**Tracing dynamics of lexical access in a language switching paradigm. Evidence from a longitudinal and a cross-sectional study.** ZOFIA WODNIECKA<sup>1</sup>, JAKUB SZEWCZYK<sup>1</sup>, PATRYCJA KAŁAMAŁA<sup>1</sup>, JOANNA DURLIK<sup>1</sup>, KAROLINA ŁUKASIK<sup>1</sup> & ANDRZEJ TARŁOWSKI<sup>2</sup>; <sup>1</sup>*Jagiellonian University in Krakow*; <sup>2</sup>*University of Finance and Management, Warsaw*

We explored impact of second language (L2) exposure on dynamics of two language-control indices assessed in a language switching paradigm (LS): global L1 slowing and asymmetric switch costs (typically larger for L1 than for L2). We report two studies with unbalanced Polish-English high-school students. In both, analyses involved mixed-linear models which allowed tracing trial-to-trial dynamics.

Study 1 employed longitudinal approach and tested impact of classroom L2 immersion across a 2 year period (3 testing stages). The pattern of results remained stable across three stages: general L1 slowing was accompanied by asymmetrical language switch costs. However, in each stage the asymmetry changed during the task: at the beginning, we observed larger switch costs to L2 than to L1, whereas at the end - larger switch costs to L1 than to L2. The initial reversal of the typically observed language switch cost asymmetry might have been due to the fact that by design the LS was always preceded by a block of tasks in L2. Hence, the experimentally increased L2 activation seemed to initially reverse language switch costs asymmetry. In Study 2, we further explored the impact of language pre-activation on switch costs asymmetry by manipulating (between-subjects) language exposure directly prior the LS. Contrary to Study 1, no global L1 slowing was observed. At the same time, the group with prior L2-exposure experienced largest lexical access difficulty in LST, in both languages. No language switch cost asymmetry was observed.

We conclude that the switch costs and global L1 slowing effect are driven by two independent mechanisms. While the switch costs reflect task-adaptation by balancing activation between languages, the global L1 slowing reflects residual language activation. Initially, exposure to L2 hampers both L1 and L2 and only after prolonged time can lead to reversal of language dominance.

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.. 10:00 – 10:20 (125) ..

**Dual-task processing at the global level of task-pairs.** PATRICIA HIRSCH, SOPHIE NOLDEN & IRING KOCH; *RWTH Aachen, Germany*

We present a series of experiments in which we examined whether Task 1 (T1) and Task 2 (T2)

in dual-task situations are represented as a single more complex task-pair, such as starting a car with the overlapping subtasks of releasing a clutch and pressing the gas pedal. To investigate this question, we developed a new empirical approach, called the task-pair switching logic, and implemented it into the psychological refractory period (PRP) paradigm. According to this logic, at least three tasks are combined to different task-pairs (i.e., PRP trials). Whereas T1 is constant across task-pairs, T2 varies across task-pairs or vice versa. The sequence of the task-pairs is manipulated, resulting in task-pair repetition trials and task-pair switch trials. In task-pair repetition trials, the task-pair equals that in the previous trial (e.g., Task-Pair 2 followed by Task-Pair 2), whereas in task-pair switch trials, the task-pair differs from that in the preceding trial (e.g., Task-Pair 1 followed by Task-Pair 2). Using this empirical approach, we showed that performance is worse in task-pair switch trials than in task-pair repetition trials, resulting in task-pair switch costs. These costs indicate that T1 and T2 are represented as a single more complex task-pair, including T1 and T2 as subtasks. In further experiments, (1) we disentangled cue-switching from task-pair switching and we examined (2) whether task-pair representations are activated by cues, (3) how T1 and T2 are organized within these task-pair representations, and (4) whether inhibition is the crucial selection mechanisms at the global level of task-pairs.

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.. 10:20 – 10:40 (126) ..

**Identifying the mental architecture responsible for perceiving animate movement in a change detection task.** BRUCE STEVENSON<sup>1</sup>, ANDREW GATUS<sup>2</sup> & PETER QUAIN<sup>1</sup>; <sup>1</sup>*University of New England, Australia*; <sup>2</sup>*Australian Catholic University, Australia*

Does the identification of animate movement involve pre-attentive perceptual processes or post-perceptual inferences? The mental architecture responsible for the identification of animate movement is important for interactions with our environment, and is still to be determined. In contrast to much of the work in this area which has relied upon introspective data, this study used a dual task paradigm plus response time data to investigate the mental processing of movement. Sixty-three participants were presented with three categories of movement - mechanical, biological and intentional - in a change detection task. Trials involved movement changes within- or between-categories, accompanied by a cognitive load manipulation. While participants focussed on the naming of digits presented in the centre of a computer screen, under low and high load conditions, they

concurrently monitored for change in either of two initially identical sequences of movements presented simultaneously in left and right visual fields. While the duration of each movement sequence was only one second, multiple cycles were presented until eventually a sensory change occurring in one of the movement sequences. Response times for change detection were recorded. Response time differences as a function of load and the type of change were used as markers to indicate qualitative differences in the processing of each movement category. This evidence for activity in different processing domains suggests that within pre-attentive processing there are dedicated processes for detecting biological properties, which are common to biological and intentional movement. There also appears to be a further post-perceptual domain for assigning intentional properties. These findings have theoretical implications for our understanding of movement perception and potential implications for individuals with deficits in the perception of agent-related intentional action.

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1 involved auditory presentation of memory lists with oral serial ordered recall. Experiment 2 involved visual presentation of the memory lists with typed serial ordered recall. In both experiments processing involved visual presentation of simple arithmetic for speeded verification, and the tasks were performed without and with concurrent articulatory suppression. The experimental designs, the analysis plan, and the differential predictions from each perspective were pre-registered on the Open Science Framework, and both experiments were run in parallel across two labs. Results in both experiments showed that memory performance declined when combined with processing during a retention interval, and there was a main effect of articulatory suppression, but no interaction. Processing showed a small decline when combined with memory in Experiment 1, but no effect of memory load in Experiment 2, and was unaffected by suppression in both experiments. Each theoretical account predicted some of the results, but none predicted the complete pattern of findings. Theoretical implications will be discussed.

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## Working Memory II H5, Tuesday, 09:00 – 10:40

.. 09:00 – 09:20 (127) ..

**Processing and storage in working memory: An adversarial collaboration.** ROBERT LOGIE<sup>1</sup>, JASON DOHERTY<sup>1</sup>, AGNIESZKA JAROSLAWSKA<sup>1</sup>, NELSON COWAN<sup>2</sup>, MOSHE NAVEH-BENJAMIN<sup>2</sup>, STEPHEN RHODES<sup>2</sup>, PIERRE BARROUILLET<sup>3</sup>, CLEMENT BELLETIER<sup>4</sup> & VALERIE CAMOS<sup>4</sup>; <sup>1</sup>*University of Edinburgh, United Kingdom*; <sup>2</sup>*University of Missouri-Columbia, USA*; <sup>3</sup>*University of Geneva, Switzerland*; <sup>4</sup>*University of Fribourg, Switzerland*

One major ongoing debate in the working memory literature is whether processing and temporary memory rely on a limited capacity focus of attention, on the capacity to switch rapidly between processing and memory maintenance, or on separate cognitive resources that can operate in parallel. There have been key methodological differences between the paradigms that support each of these three different theoretical assumptions about working memory capacity. We report two experiments comparing performance on verbal memory alone, processing (arithmetic verification) alone, and recall of a memory preload with processing during a retention interval. To ensure that the memory and processing loads were each set at the limits of single task performance, both were titrated to the spans for each individual participant. Experiment

.. 09:20 – 09:40 (128) ..

**Comparing working memory performance under different instructed-refreshing schemes.** EVIE VERGAUWE & NAOMI LANGEROCK; *University of Geneva, Switzerland*

This study aims at advancing our understanding of attentional refreshing in working memory. Specifically, we will present a series of experiments that aim at understanding how refreshing affects working memory performance, by instructing participants to refresh a list of memory items in a certain way. A short list of to-be-remembered letters (e.g., K B N S) was followed by a number of refreshing cues before serial recall. Each list item was cued once, and thus, refreshed through instructions once. Importantly, the order of the refreshing cues was manipulated so to create three experimental conditions: (1) serial-cumulative order (K->B->N->S), 2) serial-noncumulative order (e.g., N->S->K->B), and 3) random order (e.g., N->K->S->B). In some experiments, we also included a baseline without any cues, allowing participants to refresh in a more spontaneous way. We examined how serial recall performance differs between the different instructed refreshing schemes, and compare it with baseline performance.

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.. 09:40 – 10:00 (129) ..

**The effect of refreshing and elaboration on working and long-term memory.** LEA MARIA BARTSCH & KLAUS OBERAUER; *University of Zurich, Switzerland*

The maintenance of information in working memory (WM) is assumed to rely on processes such as attentional refreshing or elaboration of the to-be-remembered material. Refreshing is defined as briefly thinking of an item just after the stimulus is no longer physically present but while a representation is still active (Johnson, 1992). Elaboration is defined as enriching the memory representation with associated information from semantic memory. The benefits of elaboration – for episodic long-term memory (LTM) are well documented (e.g. Craik & Tulving, 1975) and there are hints that refreshing also improves LTM (Johnson et al., 2002; Raye, 2008). We are interested in the extent to which elaboration and refreshing are distinct processes on representations in WM, which have different effects on WM and LTM retrieval. For that purpose we conducted an experiment in which immediate memory performance of a list of six sequentially presented words is compared under four different processing conditions: After initial encoding of all of the memory items, either the first or the last three words of a study list were simply read again, refreshed, elaborated, or refreshed and elaborated simultaneously. Our results show no effect of elaboration on WM, and a decline in WM performance for refreshed items compared to a read condition. LTM retrieval was highest for elaborated items, confirming that participants followed the elaboration instruction. Refreshing had no effect on LTM performance. These findings question the assumption that maintenance of verbal working memory depends on activation through attentional focussing and lead to question the immediate effect of elaboration on memory.

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.. 10:00 – 10:20 (130) ..

**Tracking Real-Time Changes in Working Memory Updating and Gating with the Event-Based Eye-Blink Rate.** RACHEL RAC-LUBASHEVSKY<sup>1</sup>, HELEEN SLAGTER<sup>2</sup> & YOAV KESSLER<sup>1</sup>; <sup>1</sup>*Ben-Gurion University of the Negev, Israel*; <sup>2</sup>*University of Amsterdam, the Netherlands*

Effective working memory (WM) functioning depends on a gating process that regulates the balance between maintenance and updating. The present study measured event-based eye-blink rate (ebEBR), which presumably reflects phasic striatal dopamine activity, to examine the involvement of dopamine in WM updating and gating. ebEBR was tracked during performance in the reference-back task. In each trial of this task, the stimulus 'X'

or 'O' was presented within a red (reference trials) or blue (comparison trials) frame. Participants were instructed to compare each stimulus to the last stimulus they saw within a red frame. Accordingly, reference trials, but not comparison trials, involved WM updating. Moreover, switching between comparison to reference trials, or vice versa, is associated with opening and closing the gate to WM, respectively. In Experiments 1 and 2, a constant sequence length of each trial-type was used thus making the switching between the trial-types predictable. In Experiment 3 the trial-type was chosen randomly, and a context cue in the form of an empty colored frame was presented before the probe. In all three experiments, reference trials (that required WM updating) and switch trials (that required gate opening and closing) were associated with an increased ebEBR. These results support the prefrontal cortex basal ganglia WM model (PBWM) by linking updating and gating to striatal dopaminergic activity. Furthermore, the cue phase results in Experiment 3, show preparatory activity in ebEBR only in gate closing but not in gate opening. This result suggests that switching to a maintenance mode, namely gate closing, is more proactive than switching to an updating mode (gate opening), which is more stimulus-driven and reactive. Together, these findings show that the ebEBR – an inexpensive, non-invasive, easy-to-use measure – can be used to track changes in WM demands, and possibly of striatal dopamine activity during task performance.

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.. 10:20 – 10:40 (131) ..

**Working memory updating, gating, and removal: lessons from the reference-back paradigm.** YOAV KESSLER & RACHEL RAC-LUBASHEVSKY; *Ben-Gurion University of the Negev, Israel*

Working memory (WM) has two major functions: maintenance, the ability to robustly hold information shielded from interference, and updating, the ability to modify the maintained information when needed. These two demands are in conflict, since updating should overcome maintenance, and vice versa. According to gating models, this conflict is coordinated by a gate which enables to alternate between maintenance and updating. Information is robustly maintained when the gate to WM is closed, while opening the gate enables updating WM with new input from the environment. Building on the notion of gating, we suggest that memory updating over the short term can take place in two forms: controlled, gating-dependent WM updating, and automatic, gating-independent updating of perceptual representations which takes place outside WM. The reference-back paradigm, a novel version of the n-back, was designed to tease apart these two types of updating. In each trial of

this task, participants are presented with a stimulus that appeared inside a red or a blue frame. The task is to indicate whether or not the currently presented stimulus is identical to the one that appeared inside the most recent red frame. Trials involving a blue frame ("comparison trials") only require a same/different decision, but not WM updating. Trials involving a red frame ("reference trials") also require WM updating, since the stimulus that appears in such trials would serve as a reference for comparison in future trials. Switching from comparison to reference trials, and vice versa, corresponds to gate opening and closing, respectively. We will show how the reference-back paradigm enables separating the gating process from actual updating, and present data that supports our distinction between automatic and controlled updating within this paradigm. Finally, we will demonstrate that removal of outdated items takes place as part of WM updating but not of automatic updating.

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Secondly, we bring new empirical insights about how these cues are testifying of the extrageniculate implication in attention. These pathways lack of small-wavelength retinal cells input, and hence are blind to S-cone color transition. In a tachistoscopic task, previous studies showed that still items of different size triggered a progression of attention from the most to the least salient item. S-cone items prevented such hierarchy. However, extrageniculate pathways have been linked to the conveying of motion-energy information (i.e. objectless spatiotemporal changes) toward parietal areas for attention, and this without awareness. We adapted the task to display black or S-cone moving items of different speed and reported the salience-based progression of attention in both color conditions, although S-cone stimulation was not consciously perceived. This argued for an involvement of extrageniculate pathways in attention, motion detection and in blindsight.

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.. 09:20 – 09:40 (133) ..

## Neurobiology and Development H6, Tuesday, 09:00 – 10:40

.. 09:00 – 09:20 (132) ..

**Using behavior to explore the subcortical correlates of attention.** RAPHAËL MIZZI & GEORGE A. MICHAEL; *Lumière Lyon 2 University, France*

Since the first studies exploring the neural correlates of blindsight, the literature is accumulating evidence regarding the implication of certain subcortical pathways in visual attention. A large number of fibers bypasses the main geniculostriate visual pathway and projects to parietal and extrastriate areas. These are the extrageniculate pathways. Exploiting data from physiology and neurosciences, experimental psychology recently massively contributed to the exploration of the role of these pathways in attention an oculomotion using only behavioral cues.

Firstly, after a brief presentation on the key structures of visual attention, we review three cues: nasal-temporal asymmetries, responses to S-cone and perceptually suppressed stimulation. We review respective methodologic feasibility and neural correlates, then examine consistency with neurophysiological, neuropsychological, and neuroimaging findings. This part concludes that nasal-temporal asymmetries and responses to S-cone stimuli are plausible probes of extrageniculate functions, while literature is yet too scarce for responses to suppressed stimuli to be considered as a reliable cue.

**How attention drives contrast-based distortions of event perception: Evidence from event-related potentials.** ELKAN G. AKYUREK; *University of Groningen, Netherlands, The*

Generally, a pair of brief, successive stimuli is more likely to be perceived as a single event when the second stimulus has lower contrast. In such cases the stimuli more often become temporally integrated, and assigning order between them becomes more difficult. However, we found that this effect can completely reverse, so that perceptual segregation is facilitated, rather than integration. This happens when a relatively long, high contrast first stimulus is followed by a brief, low contrast second stimulus (e.g., 70ms and 10ms). To reveal the mechanisms underlying this reversal, we turned to measuring event-related potentials. Stimulus contrast modulated amplitude on the N1, N2pc, and P3 components, each of which was previously implicated in temporal integration. A condition in which contrast was mixed, so that stronger and weaker elements were distributed across the stimulus displays, and a condition in which a low contrast first stimulus appeared, both exhibited lower N1 amplitude. On the N2pc and P3, the differential amplitudes further developed. The results suggest that attention is involved in the perceptual segregation that occurs unexpectedly when a low contrast second stimulus follows a longer, high contrast first stimulus. As the observed differences continued to unfold across the components of the event-related potential, contributions from earlier as well as later phases of attentional processing seem likely. An attempt to model the results conceptually through simple neural activation dynamics is proposed.

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.. 09:40 – 10:00 (134) ..

**Semantic incongruity attracts attention but does not help identification and future memory of incongruent objects: the role of right TPJ.** JUAN LUPIÁÑEZ, JAVIER ORTIZ, ELISA MARTÍN-ARÉVALO & ANA CHICA; *Universidad de Granada, Spain*

Unpredicted objects, i.e., those that do not fit in a specific context, quickly attract attention as a mean of extracting more information about potentially relevant items. However, in spite of attracting attention, those objects are worse identified. By making use of a change detection task, in which we manipulate the semantic congruity between the to-be-detected object and the background scene, we show that semantic processing triggering this attraction of attention can occur before the objects are consciously detected. In subsequent experiments we have shown that memory for those objects is worse for semantically incongruent than congruent objects. In another experiment we applied inhibitory repetitive Transcranial Magnetic Stimulation (rTMS) over the right temporo-parietal junction (right TPJ) and to a control location (vertex) to test the causal role of the former in the processing of objects at a pre-conscious level. Our behavioural results clearly show that, indeed, even when low level features are controlled for, semantic congruity can impact in opposite ways detection and identification processes: incongruent objects are quickly detected but poorly identified. Importantly, rTMS over the right TPJ effectively diminishes contextual guidance effects on attention. These results suggest that at least some high order category processing takes place before conscious detection to direct attention toward the most informative regions of space, and the right TPJ seems to be involved in those processes.

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.. 10:00 – 10:20 (135) ..

**The contribution of activation and suppression mechanisms to the development of conflict processing across childhood: a large cohort study.** SOLÈNE AMBROSI<sup>1</sup>, BORIS BURLE<sup>2</sup> & AGNÈS BLAYE<sup>1</sup>; <sup>1</sup>*Laboratoire de Psychologie Cognitive - CNRS UMR 7290 & Aix Marseille University, France*; <sup>2</sup>*Laboratoire de Neurosciences Cognitives - CNRS UMR 7291 & Aix Marseille University, France*

Conflict processing, one of the hallmarks of cognitive control, is usually assessed using Simon, flanker, and Stroop tasks contrasting compatible and incompatible trials. Incompatible trials entail both an automatic capture of the response associated to the irrelevant stimulus dimension, and a subsequent suppression of this capture to ensure the production of the correct response (Kornblum et al., 1990). In adults, distribution analyses of ac-

curacy as a function of response times (Conditional accuracy function – CAF's) allow to study the time course of these two processes (see Ridderinkhof et al., 2004 for overviews), which differ in the three conflict tasks.

In children, the heterogeneity of dependent variables and the variety of conflicts from one task to the other prevent firm conclusion on the developmental path of the underlying processes. The present study focused on the development of these processes in a flanker, Simon and Stroop task.

Child-adapted version of the three conflict tasks were presented to 360 5-to-15-year-old children in a within-participants design. CAF analyses revealed that fast responses on incompatible trials were more error-prone than slow ones whereas accuracy on compatible trials stayed uniformly high across response times. This drop of performance on incompatible fast trials highlight the early incorrect response capture in children as young as 5 years of age and across all three tasks. The transient nature of this drop which disappears with longer response times evidences the suppression process. The dynamics of both response capture and suppression depend on children's age and on conflict tasks.

Altogether these findings shed new light on the development of conflict processing: these two processes are already at play from 5 years onwards, and develop slowly and steadily. Results will be discussed in the more general debate on the mechanisms underlying efficient suppression of the incorrect response.

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.. 10:20 – 10:40 (136) ..

**Computerized Progressive Attention Training (CPAT) in Adults with ADHD: Near and Far Transfer Effects.** LILACH SHALEV<sup>1</sup>, TAMAR KOLODNY<sup>2</sup>, PNINA STERN<sup>1</sup>, Yael ASHKENAZI<sup>2</sup>, MORAN FARHI<sup>1</sup>, RICARDO TARRASCH<sup>1</sup> & SHLOMIT TSAFRIR<sup>3</sup>; <sup>1</sup>*Tel-Aviv University, Israel*; <sup>2</sup>*the Hebrew University of Israel*; <sup>3</sup>*Clalit Health Services, Israel*

Higher education students with ADHD cope with various academic obstacles such as difficulty to sustain attention while studying and deficient ability to focus attention effectively on academic tasks. Shalev, Tsai, and Mevorach, (2007) have developed a computerized progressive attentional training (CPAT) program for children with ADHD, which is composed of four sets of structured tasks designed to uniquely activate the various attentional functions. With children, eight weeks of training with the CPAT program resulted in significant functional and behavioral improvements. Here I will present a couple of intervention studies with higher education adults diagnosed with ADHD (according to DSM-IV criteria). In the first

study we evaluated the effect of the CPAT vs. active control (computer games - CG) on attention functioning. In the second study we investigated the effects of group attention training sessions. In this study participants in the active control group received meditation training (MT). In the CPAT groups participants practiced four attention training tasks each session. Attention functioning of all participants was assessed using both objective and subjective tools three times: before the intervention (pre-test), after the intervention (post-test) and at follow-up (2-3 months later). In both studies positive sustainable effects were documented among students in the CPAT groups who exhibited significantly greater improvements in various attention functions (that were assessed by different tasks than the attention training tasks) compared to students in the CG and the MT groups. In the first study self-reported ADHD symptoms showed no improvement in both groups. Yet in the second study significant reduction in severity of ADHD symptoms was documented in both groups. Taken together, these studies demonstrated clear near transfer effects that were induced by the CPAT. Future studies are required to replicate and establish the transfer effects that were obtained in these studies.

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## Social / Motivational H8, Tuesday, 09:00 – 10:40

.. 09:00 – 09:20 (137) ..

**Turn taking enhances the Joint Simon effect for non-human co-actors.** ROMAN LIEPOLT<sup>1</sup> & ANNA STENZEL<sup>2</sup>; <sup>1</sup>German Sport University Cologne, Germany; <sup>2</sup>University of Muenster, Germany

Social interactions with non-biological agents and interactions with technical devices have become increasingly important over the last years. Recent studies investigating the interactions between humans and non-human agents showed rather inconsistent results. While the joint Simon effect (JSE) was found to be absent for non-human co-actors like virtual wooden hands, other studies showed pronounced JSEs when the co-actor was a real event-producing object. An often overlooked difference between these studies is the way these co-actors delivered response events. Studies replacing the co-actor by event-producing objects used a continuous response mode, while in studies using wooden hands, the co-actor always produced action effects in a task-related, turn-taking mode. In a series of four experiments, we systematically

tested the effects of the response mode on the size of the JSE. The JSE was larger when the co-actor produced events in a turn-taking response mode than in a continuous response mode. Furthermore, we consistently found reliable JSEs for different kinds of virtual non-human co-actors (including a Japanese waving cat, scrambled patterns, and a wooden hand), and found no difference in the size of the JSE between human and non-human co-actors. We discuss possible mechanisms explaining why a JSE might be present or absent when sharing tasks with virtual non-human co-actors.

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.. 09:20 – 09:40 (138) ..

**Sequential effects in motivational conflicts: Evidence for post-conflict speeding but not for conflict adaptation.** CHRISTINA HEITMANN & ROLAND DEUTSCH; Universität Würzburg, Germany

Sequential effects in conflict processing, such as post-conflict slowing and conflict adaptation, have been extensively studied in stimulus-response compatibility (SRC) tasks, such as the flanker or Stroop task.

Although some researchers suggest that similar processes play a role in higher-level motivational conflicts, we propose that SRC-based theories on conflict processing cannot be applied to motivational conflicts such as approach-approach (AA) and avoidance-avoidance (VV) without modification. A main reason for this is that AA and VV conflicts have an intrinsic valence and motivational orientation, which we expect to modulate sequential effects.

First, we expected that the approach motivation component of AA conflicts induces a short-lived increase in action-readiness, thereby inducing speeding after AA conflicts instead of post-conflict slowing, which is typically observed in SRC settings. Second, as conflict adaptation was shown to be enhanced with the induction of negative affect, we expected conflict adaptation to be more pronounced in VV conflicts than in AA conflicts.

To test these predictions, we conducted three experiments with a newly developed research paradigm in which participants repeatedly solved AA, VV, or no conflicts (NC) by choosing one of two valent vignettes. In Experiments 2 and 3, we manipulated the intertrial interval (ITI) to examine the time course of sequential effects in motivational conflicts.

We observed post-conflict speeding in Experiment 1 and the short ITI condition of Experiment 2 and 3. In contrast, conflict adaptation proved to be less reliable as the effect was observed in AA and VV conflicts in Experiment 1, in VV conflicts in both ITI conditions of Experiment 2, but was completely absent in Experiment 3.

These results extend previous research and theory on sequential effects in conflict processing by showing that sequential effects emerge in higher-level motivational AA and VV conflicts and are modulated by the type of conflict.

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.. 09:40 – 10:00 (139) ..

**Finding a balance between the sexes: The effect of overt or covert sexism.** MIKE NICHOLLS, ELLIE ANIULIS, NICOLE THOMAS, OWEN CHURCHES, BLAKE LAWRENCE & DANIELLE CLODE; *Flinders University, Australia*

There is an unfortunate bias for females to be systematically underrepresented in everyday life, from extra scenes in movies to Lego figures. We sought to understand the origins of this social bias using the techniques of experimental psychology. Participants viewed a rectangular 30-item array containing various proportions of males and females and indicated whether the number of males and females was the same or not. If there is no bias in the representation of the sexes, the peak of 'same' responses should be centred around the point of objective equality. Instead of this, the peak was shifted towards more females. That is, there needs to be more females in the array for an observer to think they are the same. Over four experiments, we observed this shift for (a) faces, (b) faces with the hair removed, (c) full figures and (d) toilet sign icons. The bias occurred irrespective of whether the observer was male or female. The bias disappeared when participants determined the sex of hens and roosters. It therefore seems that the number of human females are systematically underestimated. We are currently determining whether this underestimation is related to overt or covert sexism.

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.. 10:00 – 10:20 (140) ..

**Anticipation-based oculomotor control in social and non-social information processing contexts.**

EVA RIECHELMANN, ANNE BÖCKLER, TIM RAETIG & LYNN HUESTEGGE; *Würzburg University, Germany*

In accordance with ideomotor control theories efficient gaze control is assumed to be associated with the anticipation of its effects (i.e., the perception of the postsaccadic object), which requires the acquisition of learned associations between saccades (i.e., actions) and their visual effects. However, only few eye movement studies have addressed the underlying mechanisms of this phenomenon. While previous research predominantly focused on the investigation of non-social effect signals, the present study incorporated social (the perception of faces that respond to the participant's

gaze with either direct vs. averted gaze) and non-social (but comparable to social gaze stimuli with respect to shape and size) targets as effect signals. In two eye tracking experiments, we focused on the question of whether social information processing in the anticipation of saccadic action-effects (Experiment 1 and 2) is special, and on the impact of exogenously vs. endogenously triggered saccades when acquiring action-effect associations (Experiment 2). To examine the occurrence of anticipation, both experiments included congruency manipulations to prime or interfere with any anticipated representation of the subsequent effect signal. We observed congruency effects for both social and non-social stimuli, indicating the occurrence of effect anticipation (in both saccade latencies and error rates). These results suggest that corresponding action control mechanisms generalize to the oculomotor domain in the context of social gaze interaction. Interestingly, social and non-social effect signals elicited different result pattern regarding specific types of changes of the effect signal, potentially suggesting different underlying control mechanisms. Results are discussed within the existing literature on the dynamics of arbitrary action effects and on social information processing, and serve to contribute to a better understanding of gaze control mechanisms and social gaze interaction.

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.. 10:20 – 10:40 (141) ..

**Meaningless gestures need more social skills than meaningful gestures to be processed: evidence from developmental and eye tracking data.**

MATHIEU LESOURD, KIRSTY BRAY, CHLOÉ RIPOLL, JULIE JANNAULT, OLGA GHERASIM & AMANDINE E. REY; *Laboratoire d'Etude des Mécanismes Cognitifs (EA 3082), France*

Intransitive gestures include meaningful gestures (e.g., waving goodbye) and meaningless gestures. While it is well admitted that meaningful gestures are highly communicative and expressed by intentional bodily movements of a person addressing somebody else, the social features of meaningless gestures have not been yet considered. However, as the meaning of gestures are dependent on a certain cultural context (Kendon, 1997), social skills may be needed for the processing of both meaningful and meaningless gestures. Here, we report evidence from developmental and eye tracking data in favor of the involvement of social skills to process intransitive meaningless gestures. Two groups of participants were recruited: 23 children (aged 6 to 9 years) and 21 adults (aged 18 to 25 years). Participants performed a categorization task of meaningful and meaningless intransitive gestures as quickly and accurately as possible.

An eye-tracking recording was performed during the categorization task only in adults. To investigate the relation between gestures recognition capacities and social cognition, all participants completed a false belief test evaluating the theory of mind (TOM-15, Desgranges et al., 2012). Results showed that children performed lower for meaningful than meaningless gestures, whereas there was no difference in adults, indicating that children had a smaller action lexicon. In both groups, the higher the performance of social cognition, the higher the performance in recognition for meaningless gestures. Thus, since childhood, social skills seem more important in the recognition of meaningless than meaningful gestures. This observation is corroborated by gaze data in which adults spend more time in the region of interest related to the face for meaningless than meaningful gestures indicating a supplementary research of social information for meaningless gestures.

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## Numerical Cognition II H1, Tuesday, 12:50 – 14:30

.. 12:50 – 13:10 (142) ..

**Inflexible use of finger counting in 5- to 6-year-old children.** CATHERINE THEVENOT<sup>1</sup> & JUSTINE DUPONT-BOIME<sup>2</sup>; <sup>1</sup>*University of Lausanne / Institute of Psychology, Switzerland*; <sup>2</sup>*University of Geneva / Psychology Department, Switzerland*

In the experiment reported here, 5 to 6-year old children were presented sequentially with a series of pictures and were asked to count the number of pictures while naming them. Because the phonological loop is blocked during the task, it is hardly possible to count the pictures without keeping track of the number of pictures on fingers. Out of 86 children, 31 used their fingers in order to perform the task. The same 86 children were also asked to solve simple additions and we observed whether or not they counted on their fingers. Almost all children who used their fingers in the picture naming task also used them in the addition task (i.e., 28 out of 31). In contrast and interestingly, half of the 55 children who did not use their fingers in the picture naming task, used them in the addition task. Therefore, children can implement a finger counting strategy in an arithmetic task but do not think of using the same strategy in a different task when it is nonetheless a condition of success. We conclude that children can be inflexible in their use of finger counting because they cannot transfer their clever strategy from one numerical task to another.

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.. 13:10 – 13:30 (143) ..

**How many digits are there in a multi-digit number?** JAVIER GARCÍA-ORZA, JUAN A. ÁLVAREZ-MONTESINOS, ISMAEL R. MONTENEGRO & MARINA CUADRA; *Numerical Cognition Lab. Universidad de Málaga, Spain*

The processing of multi-digit numbers have been usually studied comparing numbers with the same number of digits. In these cases, deciding which number is bigger simply requires comparing the leftmost digit of each number. However, everyday live usually involves comparing natural numbers that differ in string length, in these cases focussing in the number of digits in each multi-digit provides the most relevant information. The present research explores in second graders (aged 7-8) the processing of the number of digits. Participants were presented with pairs of numbers that may have the same number of digits (3 vs 3; 4 vs 4) or not (3 vs 4). Stimuli in the different-length condition may be length-congruent (the number with more digits started with a bigger number: 2384-107) or length-incongruent (the number with more digits started with a smaller number: 2675-398). Multiple comparisons (Bonferroni-corrected) indicated better responses to pairs of different length than to pairs of the same length. Within the former condition performance was better in length-congruent pairs. Moreover, in the length-incongruent condition participants performed better than in those conditions with the same number of digits. This indicates the precedence of this rule over the single-digit comparing rule. In a second experiment, we explored to what extent the processing of the number of digits is automatic. Using the same stimuli we requested the participants to focus only in the first digit of each multi-digit and to decide which one was bigger (e.g., in the length-congruent pair 2384-107 participants should press the left key as 2 is bigger than 1; in the length-incongruent pair 2675-398 participants should press the right key as 3 is bigger than 2). Again, a congruity effect was found. Results indicated that second graders process the number of digits even though it is irrelevant for the task at hand.

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.. 13:30 – 13:50 (144) ..

**Number counts! An objective electrophysiological marker of non-symbolic number processing with Fast Periodic Visual Stimulation.** MATHIEU GUILLAUME<sup>1</sup>, SANDRINE MEJIAS<sup>2</sup>, BRUNO ROSSION<sup>3</sup>, MILENA DZHELYOVA<sup>1,3</sup> & CHRISTINE SCHILTZ<sup>1</sup>; <sup>1</sup>*University of Luxembourg, Luxembourg*; <sup>2</sup>*Université du Droit et de la Santé Lille 2, France*;

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Some authors recently challenged the claim that numerical processes specifically handle non-symbolic magnitudes and they alternately suggested that general visual and/or control executive processes could explain performance in number comparison tasks. To further investigate this issue, we set up an EEG paradigm in which we recorded neural responses to the passive viewing of different arrays of basic visual forms. The stimuli sequence followed a fast and sinusoidal contrast modulation at the frequency of 10Hz (ten items per second). Visual properties of elements randomly changed from item to item, but their number was manipulated: in a control condition, arrays always contained the same number, and in the experimental conditions, the number periodically changed (each eight iteration, at 1.25Hz). We varied the numerical ratio between the frequent and the rare number throughout the experimental conditions. We recorded significant responses on occipital and parietal electrodes to the oddball frequency and its harmonics during our experimental conditions, but not during the control condition. Crucially, the strength and the spread of the signal increased proportionally with numerical ratio  $r$ , and the EEG signal pattern was tightly related to numerosity discrimination (i.e., the Weber fraction) measured in a behavioural comparison task. The results suggest that implicit and passive viewing of quick sequences of arrays was sufficient to automatically elicit neural synchronisation to numerical magnitudes without any explicit involvement of higher general cognitive processes. The close match between behaviour and EEG recordings supports the proposal that performance measured in non-symbolic number comparison tasks cannot exclusively be explained by non-numerical visual cue processing and/or higher cognitive functions.

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.. 13:50 – 14:10 (145) ..

**Response times for arithmetic and dot enumeration reveal a common combinatorial process.**

JASON D FORTE & ROBERT A REEVE; *The University of Melbourne, Australia*

Background: The reported correlation between the time taken to count dots on a screen and perform simple addition has been attributed to a combinatorial process that underlies both dot enumeration and arithmetic. The finding that enumeration of dots grouped into sets less than five is faster than dots arranged randomly shows that perceptual grouping of dots in random dot arrays contributes to enumeration response times. We devised a paradigm that uses multiple number representations to control perceptual grouping and reveal a combinatorial process in arithmetic and dot

enumeration tasks that accounts for the correlations found in the literature.

Methods: We recorded the time taken for fifty undergraduate students to enumerate sets of dots and add numbers with totals from 1 to 16. Stimulus representations for each total were arranged in 4 ways. The “random” representation had dots arranged randomly. In the “quad dot” configuration, dots were arranged into four groups. The “add four” representation was a conventional addition display using numerals that matched the quad dot subset sizes. The “add two” configuration was a conventional addition display.

Results: Enumeration times for random stimuli increased linearly above set size four as per the literature. Response times for add two configurations showed no increase with set size. Enumeration times for the quad dot representation increased non-monotonically, with relatively faster response times observed when quad clusters had the same number of dots. The response times for the add four representation increased non-monotonically in the same manner as the quad dot configuration.

Discussion: Our data show similar patterns of response times for enumeration and arithmetic when enumeration configurations do not require perceptual grouping (quad dot stimulus) and when arithmetic configurations have the same combinatorial requirements (add four). Our findings provide support for the idea that dot enumeration uses the same combinatorial processes as arithmetic.

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## Cognitive Control II

### H2, Tuesday, 12:50 – 14:30

.. 12:50 – 13:10 (146) ..

**Behavioural response patterns associated with neuroticism traits as measured through a game-based version of the Eriksen-Flanker/GoNogo task.** EMILY BOARDMAN<sup>1</sup> & LARA MONTEFIORI<sup>2,1</sup>; <sup>1</sup>*Arctic Shores, United Kingdom*; <sup>2</sup>*University College London, United Kingdom*

Neurobiological models of personality specify that traits such as neuroticism, openness to experience and extraversion can be differentiated between individuals on the basis of specific behavioural responses elicited by particular cognitive tasks. Previous research has established correlations between self-reported levels of neuroticism and individual differences in response latency, response inhibition, and intra-individual differences in response latency in cognitive control tasks.

We created a novel, gamified version of the Eriksen-Flanker/ GoNogo-task as part of a mobile game-based assessment. 270 participants completed the game and subsequently responded to a self-report measure of neuroticism.

The expected effects on the basis of the existing literature in the Flanker task were replicated. There were significantly more errors and slower reaction times in incongruent trials compared to congruent trials. The withdrawal factor of neuroticism was negatively correlated with performance in No-go trials, and the volatility factor of neuroticism negatively correlated with performance in Go trials. Degree of neuroticism was also associated with differential patterns of intra-individual variation in reaction time.

These results build on the findings of previous studies surrounding the cognitive markers of personality with a large sample, while providing evidence that game-based versions of cognitive tasks can provide implicit measures of personality.

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.. 13:10 – 13:30 (147) ..

**Influence of nutritional strategies on cognitive functions and rating of perceived exertion during acute submaximal running exercise in high level athletes.** LAURA POMPORTES<sup>1,2,3</sup>, JEAN-ICK BRISWALTER<sup>1</sup>, LAURENCE CASINI<sup>4</sup>, ARNAUD HAYS<sup>5</sup> & KAREN DAVRANCHE<sup>3</sup>; <sup>1</sup>Côte d'Azur, Laboratoire Motricité Humaine Expertise Sport Santé, Nice, France; <sup>2</sup>CREPS PACA, Aix en Provence, France; <sup>3</sup>Aix-Marseille Université, CNRS, LPC, Laboratoire de Psychologie Cognitive, Marseille, France; <sup>4</sup>Aix-Marseille Université, CNRS, LNC, Laboratoire de Neurosciences Cognitives, Marseille, France; <sup>5</sup>Aix-Marseille Université, UMR 7287. Institut des Sciences du Mouvement, Marseille, France

**Background:** The aim of the present study was to investigate the effect of different nutritional supplementation ingestions on cognitive performance and rating of perceived exertion (RPE) prior to and after one 40-minutes submaximal treadmill running exercise (i.e., speed corresponding to a RPE 13 determined during a preliminary session).

**Method:** Ten high level pentathlon modern athletes completed 4 counterbalanced experimental sessions, corresponding to ingestions of either carbohydrate (CHO: 3000 mg, 6%), guarana-ginseng (GUA: 400 mg), caffeine (CAF: 200 mg) or placebo (PL). Cognitive performance was assessed through a time perception task and a conflict task (the Simon reaction time task): 1) prior to exercise and ingestions, 2) prior to exercise but after one 250 ml ingestion, and 3) after exercise and two additional ingestions of 125 ml each distant from 25 minutes. The RPE was recorded at 10, 20, 30 and 40 minutes after the exercise onset.

**Results:** The results have shown that after exercise, reaction times were faster and participants produced shorter durations in the time perception task. Moreover, they also have revealed that: 1) CHO, CAF or GUA ingestion enhanced the speed of information processing after exercise compared to PL, 2) GUA ingestion improved information processing in terms of accuracy after exercise compared to PL, and 3) CAF and GUA ingestion led to a decrease in subjective perception of effort during exercise compared to PL.

**Discussion:** All nutritional strategies seem to present ergogenic effects on cognitive performance after exercise. Interestingly, the improvement of cognitive performance by exercise could be explained by a cortical arousal increased induced by modulations of the noradrenergic and dopaminergic systems. These findings suggest that, although CAF and CHO ingestions seem to be attractive nutritional supplementations to improve cognitive performance, GUA ingestion presents additional benefits to improve performance more specifically in sports requiring high cognitive control.

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.. 13:30 – 13:50 (148) ..

**Meditation-induced cognitive-control states affect moral decision making.** ROBERTA SELLARO & BERNHARD HOMMEL; *Leiden University, Netherlands, The*

Previous research has shown that different types of meditation techniques can be effectively used to bias an individual's metacontrol state towards either goal-persistence or flexibility. Importantly, meditation-induced cognitive control states extend beyond the session of meditation and affect performance in subsequent, unrelated tasks.

In the present study, we aimed at extending previous findings to assess whether meditation-induced metacontrol states can affect the amount of utilitarian responses (i.e., harming one person to save many) when making moral judgments.

Participants underwent a brief single session of either focused attention meditation (FAM), which is thought to increase top-down control, or open monitoring meditation (OMM), which is assumed to weaken top-down control, before performing a moral judgment task. In this task, participants were presented with 12 high-conflict personal moral dilemmas and had to decide whether to accept or not each given solution (utilitarian vs. non-utilitarian response). Results showed that engaging in FAM made participants more likely to endorse utilitarian options, thereby suggesting that this form of meditation can promote outcome-based decisions.

The present results are consistent with previous findings suggesting that utilitarian responses are favored by increased cognitive control and confirm

previous observations that engaging in meditation instantly creates a cognitive-control state that has a specific impact on the individual's processing style.  
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.. 13:50 – 14:10 (149) ..

**Crowding is modulated by target and flanker valence.** FERDINAND PITTINO, ANJA KURZ & ANKE HUCKAUF; *General Psychology, Ulm University, Germany*

Crowding refers to the phenomenon that an object in the visual periphery is harder to be identified when it is surrounded by adjacent flankers. The aim of the present study was to investigate whether crowding effects are influenced by target and/or flanker valence. Given that emotional material is prioritized in processing, we expected to find enhanced identification of emotional target stimuli. Further, since emotional stimuli are more distracting than neutral ones, we expected more interference for emotional compared to neutral flankers.

To control for possible low-level differences between negative and neutral stimuli, we applied the evaluative conditioning paradigm and repeatedly paired Landolt Rings with neutral or negative IAPS-pictures. Subsequently, the conditioned stimuli (CSnegative and CSneutral) were used in a visual crowding task. We determined the critical spacing (75% threshold) for two conditions: a) CSnegative and CSneutral targets were surrounded by neutral (not-conditioned) flankers and b) neutral targets were surrounded by the CSnegative or the CSneutral.

Subjective ratings clearly replicated the common evaluative conditioning effect: After conditioning, the Landolt Ring associated with negative pictures (CSnegative) was rated more negative and more arousing than the one paired with neutral pictures (CSneutral). Furthermore, we found evidence for smaller critical spacings for CSnegative relative to CSneutral target conditions, indicating enhanced recognition of the CSnegative. Additionally, we observed larger critical spacing when the target was surrounded by CSnegative compared to CSneutral flankers, indicating more interference with CSnegative flankers.

In conclusion, the results suggest that crowding effects are modulated both by target and flanker valence. Our study further demonstrates that the evaluative conditioning paradigm can be successfully used to study the influence of emotion on rather early perceptual processes.

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.. 14:10 – 14:30 (150) ..

**Interference from Non-target Items in Change-detection Task.** HSUAN-YU LIN & KLAUS

OBERAUER; *University of Zurich, Switzerland*

The studies of visual-working memory often employ change-detection task and continuous-stimulus reproduction task. In continuous-stimulus reproduction task, participants occasionally report around the non-target items instead of the target. The presence of non-target response is particularly important for Interference Model which relies on the interference of non-target items to explain the set-size effect (Oberauer & Lin, 2017). However, because of the nature of the response scheme in continuous-stimulus reproduction task, it is difficult to identify if the response is reporting a non-target item or the imprecision from reporting the target item. To investigate the non-target response, we used single-probe change-detection task with stimulus from continuous dimension. The probe was either from the target, the non-target items, or the remainder of the possible stimulus space. By presenting the probe from the non-target item, we can investigate the amount interference from non-target items directly. The intrusion cost, the decrease of performance to reject the probe from the non-target items comparing to the probe from the remaining of the possible stimulus space, was found. The intrusion cost shown an increase between set size two and set size three but stayed relatively constant throughout the remaining set sizes. We fitted the Interference Model to the result of change-detection task with Bayesian Inference rule similar to the one used in Keshvari, van den Berg, & Ma (2013). The Interference Model was generally successful in predicting the performance including the intrusion cost. However, the Interference Model under predicted the intrusion cost at set size two. The existence of intrusion cost proposes a challenge for the memory models which do not predict non-target response, and the set-size effect of the intrusion cost also proposes a challenge for Interference Model. (290 words)

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## False Memory H5, Tuesday, 12:50 – 14:30

.. 12:50 – 13:10 (151) ..

**False memory at short term: Does working memory generate them ?** MARLÈNE ABADIE & VALÉRIE CAMOS; *University of Fribourg, Switzerland*

Background:

False memories are a well-established long-term memory phenomena. However recent research reported false recognition at short term, suggesting that working memory could also give raise

to false memories (e.g., Atkins & Reuter-Lorenz, 2008). Alternatively, we hypothesized that working memory maintenance has been impaired in these studies. Recall relying then on long-term memory, shows false recognition at short term. To test this proposition, we reported two experiments in which the availability of maintenance mechanisms in working memory was manipulated. Previous studies used associative related word-lists to stimulate false memories. Associative relatedness between memory words was also varied in the present study.

#### Method:

Associatively related versus unrelated four word-lists were retained over a short interval immediately followed by a recognition test. In Experiment 1, the retention interval was filled with a high attentional demanding task and a concurrent articulatory suppression to prevent the maintenance of memory lists through attentional refreshing and articulatory rehearsal, respectively. In Experiment 2, a low attentional demanding task without articulatory suppression was used so that both maintenance mechanisms were available.

#### Results:

Results of Experiment 1 did replicate the false recognition effect in the immediate test, with false recognition of related distractors higher when related word-lists were presented compared to unrelated word-lists. By contrast, this effect disappeared in Experiment 2, the false recognition rate being low and similar in both lists.

#### Discussion

These findings suggest that the occurrence of the false memory phenomenon in immediate test is due to the obstruction of working memory maintenance mechanisms. Hence, false memories at short term are relying on retrieval from long-term memory rather than from working memory.

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.. 13:10 – 13:30 (152) ..

#### **The Influence of Misinformation Manipulations on Evaluative Conditioning.** TAYLOR BENEDICT & ANNE GAST; *University of Cologne, Germany*

Evaluative conditioning (EC) is a change in the valence of a conditioned stimulus (CS) due to previous pairings with a positive or negative unconditioned stimulus (US). EC is relevant for understanding the acquisition of implicit and explicit attitudes. It is often assumed that attitude acquisition is based on implicit or unconscious learning. Several studies suggest, however, that EC is mediated by explicit memory. Therefore, EC may be susceptible to the same factors that influence memory, such as misinformation manipulations, which can create false memories. Our preregistered study integrated the misinformation effect into the EC paradigm by

falsely suggesting that some of the CSs had been paired with different USs, which had been previously shown. After the conditioning phase, the participants answered detailed questions about the USs while receiving inaccurate suggestions indicating that the CSs had been paired with a different US with the opposite valence. Other pairs were questioned with accurate suggestions, while the remaining pairs (controls) were not questioned at all. We found that this manipulation significantly moderated EC effects. For the pairs that were combined with inaccurate information we found a reverse EC effect, while we found a typical EC effect for both control pairs and pairs combined with accurate information. Manipulation checks showed that the misinformation effect successfully moderated memory for the pairs, as performance was reduced in the misinformation condition. The results support the relevance of explicit memory for EC effects and are therefore also relevant for understanding the processes underlying the acquisition of attitudes.

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.. 13:30 – 13:50 (153) ..

#### **Illusory control among false memories: insights from DRM, WM & attention studies.** PATRYCJA MACIASZEK; *Jagiellonian University, Krakow, Poland*

Notwithstanding the increasing number of studies focused on false memory over the past decade, cognitive mechanisms underlying this phenomenon still remain unestablished. The aim of this paper is to integrate two main approaches aiming to explain laboratory-evoked false memories (FM). First, the relevance of activation spread in a memory network is examined (Quillian, 1969; Collins & Loftus, 1975). Along with this, research was also addressed to investigate the impact of working memory (WM) efficiency among its storage and processing capacities on a tendency to generate FM by individuals. Finally, the ability of inhibit irrelevant stimuli among WM content and control ongoing processes and its relationship with FM rates was considered (Oberauer, 2002, 2014).

Two experiments (N=200) employing the Deese-Roediger-McDermott paradigm (list of words related) and cognitive tasks (n-back, running-span, automated-OSPAN, Stroop-interference-control-task) were conducted. Experiment 1 (N=114) was to establish whether increasing activation of memory network by adding an extra, highly-related, but non-presented word to each of 8 list would affect recognition results. Unexpected pattern of results, to some extent contrary to intuition was revealed in this study. Experiment 2 (N=86) disclosed the significant impact of WM processing efficiency (not: sole storage capacity) on a tendency to create FM.

Taken together, reported studies demonstrated



significant differences amidst individuals' tendency to change memory content and create false memory illusions in line with experimental condition. The magnitude of this effect was related to inhibitory and control capacities. Results are wider discussed in terms of WM ability to control incoming stimuli and to coordinate ongoing processes (Atkins&Reuter-Lorenz,2008).

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.. 13:50 – 14:10 (154) ..

**I can remember if the big one is on the right: The effect of left-to-right orientation on false memory.** BIRCE BEĞÜM BURHANOĞLU, NILSU EKINCI, EMRE GÜRBÜZ, İDİL UYAY AKIN & SEDA DURAL; *Izmir University of Economics, Turkey*

There is some evidence that show the tendency to place small objects on the left and large objects on the right. In the present study we expected this tendency to affect false memory task performance when the different stimulus pairs are alternately located (congruently and incongruently to the tendency). One hundred right-handed students (61 females) participated in the study. We used 45 different stimulus pairs for 3 experimental groups; big on the left (BL), big on the right (BR), same size on each sides (SS). In the first phase of the false memory task; 9 BL, 9 BR, 9 SS pairs were shown randomly to the participants. Participants were asked to memorize the stimulus pairs. In the second phase; 3 BL, 3 BR, 3 SS pairs and mirror versions of another 3 BL, 3 BR, 3 SS pairs from the first phase and 9 (3 BL, 3 BR, 3 SS) new stimulus pairs were shown randomly. The participants were asked to report whether they saw the stimulus pairs in the first phase or not. The results showed that the responses were significantly faster for BR than BL; for SS than BL in same-pair condition; for BL than BR; for SS than BR in mirror-pair condition; for BL than BR; for SS than BR in new-pair condition. For the accuracy measures, the responses were significantly more accurate for BR than BL; for SS than BR in same-pair condition; for SS than BL in mirror-pair condition; for BL than BR; for SS than BR in new-pair condition. Our findings might imply that this tendency to place small objects on the left and large objects on the right affects our performance on memory tasks. Email: bircebegumb@gmail.com

## Applied Attention and Robotics H6, Tuesday, 12:50 – 14:30

.. 12:50 – 13:10 (155) ..

**Evaluating the effectiveness of a commercial brain training.** TILO STROBACH<sup>1</sup> & LYNN HUESTEGGE<sup>2</sup>; <sup>1</sup>*Medical School Hamburg, Germany;* <sup>2</sup>*University of Würzburg*

Commercial brain games are home-based cognitive trainings that are industrially offered and aim to enhance cognitive functioning. While compelling evidence of brain games' effectiveness on people's minds has been challenged, there are only very few attempts to systematically evaluate this effectiveness under ecologically valid conditions. Therefore, we applied commercially available working memory updating and capacity tasks during 20 training sessions. The effectiveness of this training was measured by utilizing pre- and post-assessments in (1) trained working-memory tasks (criterion tests), (2) untrained transfer tasks from the trained updating and capacity domains (near-transfer tests), as well as (3) the non-trained domains (far-transfer tests). Training as well as pre-post-assessments were completely home-based. In contrast to an active control group, a training group improved in the criterion tests, showed near-transfer effects in updating and capacity tasks as well as demonstrated evidence for far-transfer effects (i.e., in the domains processing speed, shifting, and reported cognitive failures). Thus, this study provides one of the first systematic, still yet ecologically valid evaluations of commercial brain games and their effectiveness.

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.. 13:10 – 13:30 (156) ..

**Cognitive costs of smoking and its biomarkers.** ESZTER KOTYUK<sup>1,2</sup>, JULIANNA BIRCHER<sup>3,2</sup>, ZSOLT DEMETROVICS<sup>2</sup> & ANNA SZEKELY<sup>2</sup>; <sup>1</sup>*Hungarian Academy of Sciences, Hungary;* <sup>2</sup>*Institute of Psychology, Eötvös Loránd University, Budapest, Hungary;* <sup>3</sup>*Doctoral School of Psychology, Eötvös Loránd University, Budapest, Hungary*

Research (e.g. Baxter et al., 2001) has investigated demands of smoking behavior on attentional resources using a reaction time task.

Our aim was to test if the cognitive costs of smoking are demonstrable in memory performance as well. Also, we wanted to test if non-behavioral smoking related cues (e.g. pictures) can also evoke changes in cognitive performance. Participants were asked to memorize word lists in three conditions: (1) baseline; (2) while presenting before each word either smoking related or neutral pictures for a short time (30ms); (3) while pseudosmoking (holding an unlighted cigarette and pretending to inhale at each word). Memory performance was tested with free recall after each condition. We also registered participants' electrodermal activity (EDA) during the experiment and asked about their smoking urges after each condition. Al-

most 200 university student enrolled in the experiment.

Our results are in line with the results of Baxter et al. We found that both smokers and non-smokers perform poorer in the memory task while pretending to smoke compared to baseline. This decrease in memory performance was greater in smokers, suggesting that the inhibition of smoking causes a greater cognitive cost for smokers as compared to non-smokers. The presented pictures before each word reduced the success recalls in smokers and non-smokers as well. However, when comparing the recall ratio of the neutral and the smoking related pictures, it is clear that the smoking related pictures demanded more cognitive resources in smokers. We found that these increases in the performance of smokers are due to urges caused by smoking related cues. Analyzing the registered EDA data will contribute to understand the involved biometric mechanisms.

This work was supported by the Hungarian Scientific Research Funds (OTKA K100845), the Molecule Foundation and the postdoctoral scholarship awarded to Eszter Kotyuk by the Hungarian Academy of Sciences.

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.. 13:30 – 13:50 (157) ..

**The Function of Fluency: A Potential Heuristic for Encoding.** TAMARA M ROSNER & BRUCE MILLIKEN; *McMaster University, Canada*

Much previous work with a wide variety of tasks has demonstrated that stimulus repetition facilitates item identification, (e.g., Jacoby & Dallas, 1981; Scarborough et al., 1977). Recently, we have demonstrated that although such priming procedures reliably facilitate item identification, somewhat paradoxically they can also produce poor item encoding (Collins et al., 2017; Rosner et al., 2017). The current set of experiments examines this encoding deficit with specific reference to the possible role of processing fluency heuristics on encoding. Specifically, we were interested in investigating if poor item encoding for repeated items at study is related to the finding that repetition at test can produce an illusory false recognition effect (Jacoby & Whitehouse, 1989). Participants completed an incidental study phase in which they saw a green prime followed by a red target, and were asked to read the red word aloud. They then completed a surprise recognition memory test, which was similar to the study phase, but they were now asked to identify red targets as old or new. Overall, we observed higher hits and lower false alarms for non-repeated than repeated items, though this finding varied based on prime duration. We propose that processing fluency at the time of study may be a heuristic for item encoding. Moreover,

we suggest that the previously reported effects of processing fluency at the time of retrieval (Jacoby & Whitehouse, 1989) may be a consequence of the same mechanism that impacts encoding at the time of study.

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.. 13:50 – 14:10 (158) ..

**From Reflexive to Volitional Mechanisms.** SHAI GABAY; *Haifa University, Israel*

The literature has long emphasized cerebral cortex' role in attentional orienting. In this work we applied two different strategies to determine whether subcortical regions also have a functional role in exogenous and endogenous orienting. With this purpose, an attentional cue and its ensuing target were either presented: (i) To the same eye or (ii) each to a different eye. Results demonstrated that both exogenous and endogenous orienting involves subcortical regions in humans. We also examined the attentional orienting abilities of an evolutionary older species (i.e., Archer Fish), which lacks a fully developed cortex. Fish presented a typical exogenous and endogenous facilitation. Unexpectedly, the fish also presented inhibition of return, which commonly emerges in reflexive orienting tasks, in the endogenous orienting task. These results provide a converging evidence for the evolutionary development of attentional orienting. More broadly, these results provide insights regarding "volitional abilities": The origin of volitional mechanisms relies on the scaffolding as well as on the reuse of older and more primitive neural structures.

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.. 14:10 – 14:30 (159) ..

**What can humanoid robots tell us about mechanisms of human cognition.** AGNIESZKA WYKOWSKA; *Istituto Italiano di Tecnologia, Italy*

In daily lives, being often involved in social interactions, the human brain routinely engages various mechanisms of social cognition, such as orienting of attention to where others attend (joint attention). However, it is not clear what are the conditions eliciting mechanisms of social cognition. We address this question with a novel approach to study social cognition: we use experimental protocols that engage participants in an interaction with embodied artificial agents, that is, humanoid robots. This approach allows maintaining excellent experimental control while introducing embodied presence of an interaction partner, thereby increasing ecological validity, relative to standard screen-based experiments. In a series of studies, we used a modified Posner cueing paradigm, in which we cued participants' attention either by means of ro-

bot's pointing gestures (Experiment 1 & 2) or gaze shifts (Experiment 3 & 4) to a location on a screen, where a target letter would subsequently appear. In some trials, temporal characteristics of the robot movements were copied from human movements, in other trials, they were programmed as mechanistic. In Experiment 4 we additionally manipulated social engagement by gaze contact established by the robot, prior to gaze shift. Participants' task (across all experiments) was to respond to letter identity and additionally, to specify whether they perceived the robot behaviour as human-like or mechanistic. Results showed that participants were able to distinguish human-like behaviour from mechanistic behaviour, although they were not aware of the hint they used. Furthermore, the degree to which they engaged in joint attention depended on whether they perceived the robot's behaviour as human-like or not. We conclude that low-level mechanisms of social cognition are influenced by higher-order cognitive processes, such as inferred human-likeness of the observed agent. More generally, we propose that through the use of artificial agents, we can learn about human (social) cognition.

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## Priming / Lexical Decisions H8, Tuesday, 12:50 – 14:30

.. 12:50 – 13:10 (160) ..

**Taking the book from the bookshelf: Embedded word priming effects in compound words and nonwords.** ELISABETH BEYERSMANN<sup>1</sup>, YVETTE KEZILAS<sup>1</sup>, MAX COLTHEART<sup>1</sup>, ANNE CASTLES<sup>1</sup>, JOHANNES C. ZIEGLER<sup>2</sup>, MARCUS TAFT<sup>3</sup> & JONATHAN GRAINGER<sup>2</sup>; <sup>1</sup>*Department of Cognitive Science and ARC Centre of Excellence in Cognition and its Disorders, Macquarie University, Sydney*; <sup>2</sup>*Laboratoire de Psychologie Cognitive, Aix-Marseille Université and Centre National de la Recherche Scientifique, Marseille*; <sup>3</sup>*School of Psychology, University of New South Wales, Sydney*

Embedded word activation processes operating on compound words were investigated in three experiments that used masked priming in combination with lexical decision. In Experiment 1, target words were either preceded by a compound word prime (e.g., textbook-BOOK/textbook-TEXT), a compound-nonword prime (e.g., pilebook-BOOK/textpile-TEXT), a non-compound nonword prime (e.g., pimebook-BOOK/textpime-TEXT) or an unrelated prime (e.g., textjail-BOOK/jailbook-TEXT). The results

revealed significant priming effects, not only in the compound word and compound-nonword conditions, but also in the non-compound nonword condition, suggesting that embedded constituents (e.g., book) were activated independently of whether they occurred in combination with a real morpheme (e.g. pilebook) or a non-morphemic constituent (e.g., pimebook). Constituent priming occurred independently of whether the target word was the first or the second embedded constituent of the prime (e.g., textbook-BOOK vs. textbook-TEXT). In Experiment 2, significant priming effects were found for edge-aligned embedded constituents (e.g., pimebook-BOOK), but not for mid-embedded (e.g., pibookme-BOOK) or the outer-embedded constituents (e.g. bopimeok-BOOK), suggesting that edge-alignment is a key factor determining the activation of embedded words. In Experiment 3, facilitatory embedded target priming was observed in the reaction time data (e.g. blurpime-BLUR) and inhibitory embedded neighbor priming in the error data (e.g. bluepime-BLUR), which points to a lexical locus of the here observed embedded constituent priming effects.

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.. 13:10 – 13:30 (161) ..

**Balance of Probabilities Helps Processing: the Case of Serbian Homonymy.** DUSICA FILIPOVIC DURDEVIC; *Faculty of Philosophy, University of Novi Sad, Serbia*

It has been shown that multiple related senses of polysemous words (paper) help processing, whereas multiple unrelated meanings of homonymous words (bank) mostly slow processing down (Eddington & Tokowicz, 2015; Rodd, Gaskell, & Marslen-Wilson, 2002). Previous research in Serbian corroborated the processing advantage of polysemous words (Filipović-Durđević & Kostić, 2008) and revealed that in addition to number of related senses, the balance of sense probabilities also affected processing: polysemous nouns with balanced senses were processed faster compared to those with unbalanced senses (Filipović-Durđević, 2007). Similar finding was observed with homonyms, as Armstrong, Tokowicz, and Plaut (2012) reported that balanced homonyms were processed faster than those with unbalanced meaning frequencies. However, unlike polysemy effect, the effect of homonymy has not been consistently observed. Additionally, stimuli lists often comprised ambiguous words with meanings that span across different word classes (e.g. noun-verb). With this in mind, a set of homonymous and unambiguous Serbian nouns (with all meanings belonging to the category of nouns) was presented in the visual lexical decision task. A norming study was conducted in order to estimate the number of meanings, mean-

ing frequencies and balance of meaning frequencies (redundancy). In the first part of the analyses that focused on comparing of ambiguous and unambiguous words, processing disadvantage of homonyms compared to unambiguous controls was observed. In the second part of analysis that focused on homonyms, mixed-effect regression revealed no effect of number of meanings, although there was a tendency towards slower processing of homonyms with higher number of meanings. However, there was significant effect of redundancy revealing that balance of meanings probabilities facilitated processing. This finding mirrors both findings of Armstrong and colleagues (2012) observed with homonyms and those of Filipović-Đurđević (2007) observed with polysemes and will be discussed in terms of Settling Dynamics Account (Armstrong, 2012) and similar models.

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.. 13:30 – 13:50 (162) ..

**The CV pattern determines the structure of orthographic representations: evidence from magnetoencephalography.** ALAIN CONTENT, MARIA-GRAZIA RANZINI, VINCENT WENS, XAVIER DE TIÈGE & FABIENNE CHETAÏL; *Université libre de Bruxelles, Belgium*

Although much research effort has been devoted to delineate the nature of units involved in visual word recognition, no consensus has yet been reached. Recent experiments consistently indicated that the sequential organization of consonant and vowel letters –the CV pattern–, determines how letter strings are parsed into separate chunks. More precisely, each group of adjacent vowel letters constitutes the core of one perceived orthographic unit.

The present work attempted to overcome two limitations of previous studies by examining the neurophysiological correlates of this perceptual structure through magneto-encephalography. One aim was to establish that the extraction of vowel-centered units is not a late metalinguistic phenomenon but takes place during early stages of processing. The second objective was to confirm that the vowel-centered structure pertains to the word recognition system and may constitute one level in a hierarchy of neural detectors coding orthographic strings.

Twenty-four participants were scanned during a pseudoword cross-case matching task in which they had to judge pairs of stimuli as identical or different. The critical manipulation concerned pairs obtained by transposing two letters, so that the vowel-centered structure was either preserved (FOUVERT-fovuret, two vowel-letter clusters) or modified (BOUVRET-bovuret). As predicted, mismatches were detected faster when the structure was modified than when it was preserved. The con-

trast between modified and preserved-structure trials was associated with a significant difference in a cluster of gradiometers extending from 129 to 239 ms after the stimulation. Source localization for 10 ms time windows corresponding to the largest difference peaks indicated a significant effect in the VWFA around 200 ms. The results confirm the hypothesis that orthographic structure, as defined in terms of the CV pattern, is extracted during the early phases of letter string processing, and is encoded in left fusiform regions devoted to visual word recognition.

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.. 13:50 – 14:10 (163) ..

**Masked neighbor priming in deaf readers: An ERP study of lexical quality and competition.** GABRIELA MEADE<sup>1,2</sup>, JONATHAN GRAINGER<sup>3,4</sup>, KATHERINE J. MIDGLEY<sup>1</sup>, PHILLIP J. HOLCOMB<sup>1</sup> & KAREN EMMOREY<sup>1</sup>; <sup>1</sup>San Diego State University; <sup>2</sup>University of California, San Diego; <sup>3</sup>Aix-Marseille University; <sup>4</sup>CNRS

A number of studies have focused on the extent to which deaf adults activate phonology when reading, but few have considered how orthographic representations might differ between hearing and deaf readers. Previous research with hearing readers has suggested that masked priming can be used to investigate lexical competition between orthographic neighbors (e.g., time-TAME). Relative to an unrelated control condition, targets preceded by a neighbor prime elicit slower lexical decision reaction times (RTs) and larger amplitude N400s. Both effects are larger for skilled spellers, suggesting that the precision of lexical representations influences the strength of competition. Using the same paradigm with a group of deaf readers who had a range of spelling abilities, we replicated the behavioral interference effect (i.e., slower RTs for targets in neighbor pairs compared to those in unrelated pairs). However, we found evidence of N400 priming (i.e., smaller amplitude N400 for targets in neighbor pairs compared to those in unrelated pairs), which is opposite the effect reported in hearing readers. Neither effect was correlated with spelling ability in the deaf group. These results indicate that the behavioral and N400 effects of masked neighbor priming are dissociable and do not reflect the same underlying competition process. They also point to differences in lexical competition during visual word recognition in deaf versus hearing readers.

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## Symposium: Improving the Reliability, Resilience, and Impact of Cognitive Psychology H1, Tuesday, 14:40 – 16:20

.. 14:40 – 15:00 (164) ..

**The Registered Reports project: A vaccine against bias in research and publishing.** CHRIS CHAMBERS; *Cardiff University, United Kingdom*

In 2013 the journal *Cortex* launched Registered Reports, a format of pre-registered empirical publication in which peer review happens prior to data collection and analysis (see <https://cos.io/rr/>). The philosophy of Registered Reports is that in order to counteract publication bias and various forms of researcher bias (such as p-hacking and hindsight bias), the publishability of a scientific study should be decided by the importance of the research question and rigour of the methodology, and never based on the results of hypothesis testing. In this talk I will provide an update on the progress of Registered Reports at *Cortex* and beyond, including uptake by more than 50 journals, including *Nature Human Behaviour* and *Royal Society Open Science*. I will focus in particular on some of the emerging challenges of the format as it has expanded, together with insights it has offered into forms of bias within psychology research and the peer review process. Together with allied initiatives, Registered Reports are helping to reshape the incentive structure of the life sciences to place transparency and reproducibility on par with conventional indicators of scientific quality.

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.. 15:00 – 15:20 (165) ..

**Maximizing Reproducibility: Every Day Possibilities of Increasing Your Scientific Contribution.** SUSANN FIEDLER; *Max Planck for Research on Collective Goods, Germany*

Common incentive structures and evidence of irreproducibility in various areas of research discourages individual researchers in their quest for knowledge to some extent and leaves many with a sense of uncertainty about how to go about their scientific work. Discussing the problems highlighted in the current methods debate I will make concrete suggestions for increasing reproducibility within one's own research and address the potential for an increase in reproducibility across all stages of a full research project. Thereby, highlighting the opportunities that come along with small changes in every day procedures (e.g., pre-registration, documentation, buddy-systems, and transparency in reporting). Giving an overview on how one can become

part of a movement promoting a cultural shift toward open-mindedness for complex relationships and a strong interest in innovation going hand in hand with a re-defined understanding of responsibility of a social science researcher in 2017 supporting transparency and reproducibility.

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.. 15:20 – 15:40 (166) ..

**How to detect publication biases from published data? – A Monte Carlo simulation of different methods.** FRANK RENKEWITZ; *University of Erfurt, Germany*

The replicability crisis calls for a re-evaluation of the available evidence in many areas of psychological research. Among the reasons for deficient replicability are publication biases and the practice of p-hacking. Thus, a re-evaluation of published evidence requires methods that are able to detect these problems. The inventory of such methods has grown quickly recently. Some of the traditional techniques have been refined (e.g. PET-PEESE as an improved regression-based method) and completely new methods have been suggested (e.g. p-curve). There are, however, only very few comparative investigations of the relative performance of these methods. Important boundary conditions under which publication biases can be identified are unknown and it remains an open question for some of the methods whether they are also capable of detecting p-hacking. We pursued these research questions using extensive Monte Carlo simulations. Five methods of bias detection were investigated: Trim and Fill, PET-PEESE, TES, p-curve and p-uniform. Experimental data were simulated using a fixed effects model and selected for publication based on their p-values. We assessed the sensitivity and specificity of the tests for publication bias and evaluated corrected estimates of true effect sizes with regard to their unbiasedness and efficiency. Our results show that Trim and Fill is generally unsuitable to detect biases that are due to the selection of significant effects. Additional central findings are that p-curve and p-uniform react sensitively to different biases and often provide reasonable effect size estimates, but seem to yield systematically biased estimates under specific conditions. With large numbers of published effect sizes regression-based methods performed best.

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.. 15:40 – 16:00 (167) ..

**Addressing the Theory Crisis in Psychology.** KLAUS OBERAUER<sup>1</sup> & STEPHAN LEWANDOWSKY<sup>2,3</sup>; <sup>1</sup>*University of Zurich, Switzerland*; <sup>2</sup>*University of Bristol, United Kingdom*; <sup>3</sup>*University of Western Australia*

We argue that the current 'crisis of confidence' in psychological findings is to some extent due to poor theorizing. We could move our science forward by heeding a simple principle of theory development: A good theory should make unambiguous predictions not only about what can be observed (if all circumstantial details are just right), but about what will be observed, such that the absence of the predicted phenomenon counts as evidence against the theory. With this principle, the distinction between exploratory and confirmatory research can be formulated as the distinction between research testing a prediction that follows from a theory and research that does not, regardless of whether the researcher thought of the prediction before or after looking at the data. Rigorous theorizing can go a long way towards reigning in unconstrained HARKing (hypothesizing after results are known). With strong theoretical guidance, conceptual replications become more informative than direct replications because each conceptual replication actually tests the theory, with the possibility of yielding evidence against it. The need for p-hacking is much reduced because negative findings can be as informative as positive ones. Implementing theories as computational models helps formulating theories in a precise and unambiguous way that enables the deduction of testable predictions.

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.. 16:00 – 16:20 (168) ..

**Being Open but not Naked: Balancing Transparency with Resilience in Science.** STEPHAN LEWANDOWSKY<sup>1,2</sup> & KLAUS OBERAUER<sup>3</sup>; <sup>1</sup>*University of Bristol, United Kingdom*; <sup>2</sup>*University of Western Australia*; <sup>3</sup>*University of Zurich*

Discussions of the 'crisis' in psychology and other sciences are nearly exclusively focused on an inside perspective, asking how we – as scientists – can gain back confidence in scientific results. This discussion is important but overlooks the social context in which science is situated. That context has for many decades been benevolent, with scientists enjoying high public trust regardless of political orientation. There are signs, however, that this is changing: Many scientific results are being contested by non-scientific segments of society whose economic interests or world views are threatened by these results. More generally, trust of the public in science is declining on the conservative—but not liberal—side of society. We need to be aware of that context when repairing what is wrong in

our way of doing science. On the one hand, we need robust public critique, openness of data and methods, and scrutiny of our formal and informal methods not only to improve the way we produce scientific knowledge but also to gain back the public's trust. On the other hand, we need to be aware that sweeping criticism can feed into the perception that science in general is not trustworthy, and uncompromising openness can be "weaponized" by organized interest groups, such as the tobacco industry, to manufacture doubt in unwelcome scientific findings. To keep science resilient against these external threats, it needs to be critical but constructive, open but not naked.

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## Symposium: Current Directions in Voluntary Task Switching H2, Tuesday, 14:40 – 16:20

.. 14:40 – 15:00 (169) ..

**Assessing the consequences of endogenous control - Costs and benefits of voluntary task selection for learning and retrieval of attentional sets.** DAVID DIGNATH & ANDREA KIESEL; *University Freiburg, Germany*

Actions are controlled in two fundamental different ways, either by an exogenous, stimulus-driven control mode or by an endogenous, intentional control mode (Brass and Haggard, 2008). Endogenous controlled actions, in comparison to exogenous controlled actions, have distinct neurophysiological correlates (Passingham, Bengtsson, & Lau, 2010), show different types of learning (Herwig, Prinz, & Waszak, 2007) and exhibit specific perceptual biases (Haggard, Clark, & Kalogeras, 2002).

Here, we investigated whether endogenous and exogenous control modes affect the regulation of attention differently. Possibly, endogenous control could facilitate attentional regulation, because self-organization of task order allows for an optimization of cognitive (Miller, Ulrich & Rolke, 2009) and motivational (Deci & Ryan, 2010) factors. On the other hand, self-organization is an extra cognitive processes that is not required if task order is externally controlled (Kiesel & Dignath, 2016). More specifically, the process to choose a task requires executive control which could impair attentional control.

To manipulate endogenous control, we used a variation of the voluntary task switching paradigm. Participants choose on each trial between two different contexts in which they had to perform a

flanker task. Critically, each context was associated with different proportions of congruent to incongruent trials. This manipulation renders a more detailed processing strategy more favourable in one context and a more holistic processing strategy more favourable in the other context (because participants could learn the different proportions) and provides an index of attentional regulation.

Two experiments are presented that contrast an endogenous control group with an exogenous control group. To do so, we employed a yoked-control design. More specifically, stimuli and task order of each participant in the endogenous group were yoked to a participant in the cued task switching design of the exogenous group.

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.. 15:00 – 15:20 (170) ..

**Voluntary task switching in context: The role of higher-level task instructions on task selection processes.** CATHERINE M. ARRINGTON & DAVID A. BRAUN; *Lehigh University, United States of America*

In the original voluntary task switching (VTS) experiment (Arrington & Logan, 2004), participants were instructed to perform tasks “equally often and in a random order” with the analogy of flipping a coin given as an example of how tasks should be selected. In the context of this random order instruction, the expected switch proportion is 0.5 and deviations from this expected value are considered informative about the cognitive processes involved in task selection. The real world contexts in which volitional behavior occurs are unlikely to require random task sequencing, thus VTS paradigms using these instructions may be creating an unnecessarily artificial environment in which to study mechanisms of task selection. In this talk, we briefly consider the range of higher-level task instructions that have been used in VTS research, from the standard random order instructions to completely free choice environments where no instructions regarding task selection are provided. Generally as higher-level task instructions become less prescriptive, task selection favors task repetitions, which can be completed more quickly and with less effort, thus avoiding switch costs. Finally, we will report on a series of recent studies from our laboratory developing a new reward-based VTS (r-VTS) paradigm (Braun & Arrington, under review). In r-VTS each potential task is associated with a point value on each trial and the higher-level task instructions are to reach a set number of points as quickly as possible to complete the block of trials. Point values can be varied systematically, implementing a foraging environment where points favor task switches, or randomly between the two tasks. In this context, the expected switch proportion should

reflect a balance of the benefit of gaining a greater number of points and the cost of effort in switching tasks. We find evidence of such a mechanism in task selection.

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.. 15:20 – 15:40 (171) ..

**Conditioning task switching behavior.** SENNE BRAEM; *Ghent University, Belgium*

Most reward studies focus on the reinforcement of simple tasks or stimulus-response rules. However, recent theories (re)emphasized that cognitive control representations should adhere to the same reinforcement learning principles as do more basic stimulus and response representations. Here, we focused on the act of switching between different tasks, and investigated the effects of disproportionately rewarding task alternations or repetitions in a cued task switching paradigm on subsequent voluntary task switching behavior (i.e., when participants could choose which task to perform). The results show that subjects who were more rewarded for task alternations (relative to those more rewarded for repetitions) showed more task switching behavior. Moreover, this increased task switching behavior also came with a cost, with participants more rewarded for task repetitions showing a better task focus (i.e., smaller task-rule congruency effects). These results demonstrate that reward can reinforce more abstract patterns of behavior, beyond low-level stimulus or response representations.

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.. 15:40 – 16:00 (172) ..

**Neural task representations during voluntary task switching.** DAVID WISNIEWSKI<sup>1,2</sup>, LASSE LOOSE<sup>2</sup>, MARCO RUSCONI<sup>2</sup>, THOMAS GOSCHKE<sup>3</sup> & JOHN-DYLAN HAYNES<sup>2</sup>; <sup>1</sup>*Ghent University, Belgium*; <sup>2</sup>*Bernstein Center for Computational Neuroscience Berlin, Germany*; <sup>3</sup>*Dresden University of Technology, Germany*

We often need to flexibly switch between different behaviors in order to reach our desired goals. In most situations, we are not being told explicitly which course of action to pursue, we rather have to choose ourselves. The processes of switching between different behaviors voluntarily has been studied using voluntary task-switching paradigms in the past. Research often focused on the cognitive processes required to freely switch from performing one task to performing a different task. Here we do not focus on the cognitive processes required to switch between tasks however, we rather investigate the task representations on which they operate, as well as their neural basis. Are such task representations modulated by the volitional and cognitive control processes active during voluntary task-

switching? Possibly, increased control demands during task switching might enhance neural task representations in order to enhance performance. Alternatively, task representations might be invariant to changing control demands, allowing for robust performance under varying external conditions. We present two fMRI experiments to investigate this issue. In experiment 1 (Wisniewski, Goschke, Haynes (2016) *NeuroImage*, 134:450-58), we focused on the effect of volitional processes on task representations, while in experiment 2 (Loose, Wisniewski, Rusconi, Goschke, Haynes, submitted), we focused on the effect of switch-related cognitive control processes. Task representations were investigated using multivariate pattern analysis of fMRI data. Results in both experiments show a fronto-parietal network being involved in representing tasks during task-switching. Interestingly, these task representations were not strongly modulated by volitional or control processes, they were rather invariant to changes in control demands. These findings inform current debates on the functional organization of the fronto-parietal cortex, as well as the neural basis of voluntary task-switching. Email: david.wisniewski@ugent.be

.. 16:00 – 16:20 (173) ..

**Voluntary switch rate as an indicator of flexibility versus stability.** KERSTIN FRÖBER & GESINE DREISBACH; *University of Regensburg, Germany*

Goal-directed action in a constantly changing environment requires an adaptive balance between cognitive stability and flexibility. To investigate this balance the task switching paradigm is often used because task repetitions are associated with stability, whereas task switches are associated with flexibility. In this talk, we would like to demonstrate that the spontaneous voluntary switch rate (VSR) is especially well suited to investigate this balance, because it provides a relatively direct measure of flexibility versus stability. Task switching is associated with robust performance costs – switch costs –, which is why it is not surprising that participants barely switch tasks voluntarily when switching is truly optional. So, there seems to be a natural tendency to avoid switch costs resulting in a bias towards stability as indicated by a rather low VSR. But, theoretically, manipulations aimed at promoting cognitive flexibility should result in an increase in VSR. Several experiments from our lab using a hybrid task switching paradigm combining both forced- and free-choice trials recently confirmed this prediction. For example, increasing the frequency of forced task switches in forced-choice trials also increased the frequency of voluntary switches in free-choice trials. Thus it seems as if VSR is indeed a perfect indicator to track modulations of flexibility versus stability. These findings

will be discussed with respect to current theories on the flexibility-stability balance.  
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## Symposium: Symbolic or Grounded? Abstract meaning in the human mind and brain - Part I

### H5, Tuesday, 14:40 – 16:20

.. 14:40 – 15:00 (174) ..

**Grounding of abstract words in sensorimotor, linguistic and social experience.** ANNA BORGHİ; *Sapienza University of Rome & Institute of Cognitive Sciences and Technologies, Italian National Research Council, Rome, -*

Abstract concepts, as “fantasy”, refer to complex configurations of elements rather than to single, concrete objects, and their meaning is highly variable both within and across individuals. Many recent debates have focused on how abstract concepts are represented. Explaining their representation in the brain constitutes one of the crucial challenges of grounded cognition views. Abstract concepts do not represent a problem, instead, for distributional views, according to which meaning is derived from word associations; however, these views fail in providing a convincing account of concepts due to their incapacity to link symbols with extralinguistic experience. I will argue that a breakthrough in the literature on abstract concepts is represented by multiple representation approaches. Specifically, I will present the main tenets of the WAT (Words As social Tools) proposal, according to which abstract concepts are grounded in sensorimotor and emotional systems but also evoke linguistically conveyed and social information. According to WAT, to acquire abstract concepts we need to rely more on the input of others, benefiting from their explanations. I will describe recent evidence showing that the activation of linguistic experience has an embodied counterpart, the activation of the mouth. This might be due to different mechanisms: the re-enactment of their peculiar acquisition experience or to the internal re-explanation of their meaning, possibly through inner talk. I will argue that grounded multiple representation approaches not only incorporate the advantages of distributional approaches, but consider linguistic experience wholistically, not reducing it to word associations but taking into account its social aspects.

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.. 15:00 – 15:20 (175) ..

**Rethinking Embodiment: Abstract Concepts and the Flexible Mind.** GUY DOVE; *University of Louisville, -*

Abstract concepts have proven to be a significant challenge for embodied cognition because they raise difficult theoretical and empirical questions. On the theoretical front, there has always been the problem of how to capture abstract content using grounded mechanisms. On the empirical front, two related problems have arisen: first, the evidence implicating grounded mechanisms in tasks involving abstract concepts has been inconsistent and, second, there is a substantial body of evidence that implicates amodal mechanisms in such tasks. In this essay, I outline and defend an action-oriented view of embodiment that emphasizes the importance of context-sensitive flexibility and the need for dynamic multimodal coordination. This view is not simply a move to enactivism but rather an attempt to reorient our conception of the role that neural re-use plays in embodiment. It provides a theoretical framework for a pluralistic yet integrated account of how neural mechanisms handle abstract content.

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.. 15:20 – 15:40 (176) ..

**Why numbers are abstract concepts.** MARTIN H FISCHER; *University Potsdam, Germany*

The concept of number has traditionally been considered as a prototypical instance of abstract(ed) knowledge. It denotes the size of any arbitrary set of objects, thus seemingly preventing systematic correlations with sensory or motor features. Yet, numerosity does co-vary with physical parameters in perception and action. In this presentation, I describe how number processing obligatorily activates sensory and motor features: both sensory and motor processing are improved in left vs. right space following the presentation of small vs. large numbers. These links are bi-directional and suffice to identify numbers as embodied concepts. Moreover, these space-magnitude associations influence mental arithmetic and everyday quantitative reasoning (cf. Fischer & Shaki, 2014). Implications for research and theorizing will be discussed.

Reference:

Fischer, M. H. & Shaki, S. (2014). Spatial Associations in Numerical Cognition: From single digits to arithmetic. *Quarterly Journal of Experimental Psychology*, 67(8), 1461-1483.

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.. 15:40 – 16:00 (177) ..

**Learning concrete and abstract semantics: Insights from developmental and simulated language disorders.** GABRIELLA VIGLIOCCO<sup>1</sup>, ARMAND ROTARU<sup>1</sup>, ALESSANDRO LENCI<sup>2</sup>, MARTA PONARI<sup>3</sup> & COURTENAY NORBURY<sup>1</sup>; <sup>1</sup>*University College London, United Kingdom*; <sup>2</sup>*University of Pisa, Italy*; <sup>3</sup>*University of Kent, UK*

Word meanings, both concrete and abstract, can be learnt from the linguistic context in which words occur. A number of computational models have been developed that capture a variety of semantic effects in adults and children. These models, referred to as Distributional Semantic Models, use an effective computational approach to induce word meaning representations from large collections of text (corpora), based on the observation that, since semantically related words are often produced in similar linguistic contexts, contextual similarity is an effective proxy for semantic relatedness (see Clark, 2015; Erk, 2012; Lenci, 2008 for reviews). Vocabulary deficits observed in developmental language disorders (DLD) can be simulated in these models as damaging (a) learning rate; (b) size of the window used to extract cooccurrences and (c) novelty bias. In the talk, I will present data from children with DLD (compared to typically developing peers) and the results of simulations with distributional semantics models that address the following questions. First, what is the impact to the semantic network structure of damaging the parameters above (or their combination)? Second, how does such damage affect specifically abstract vocabulary?

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## Symposium: Instruction-based Automaticity

### H6, Tuesday, 14:40 – 16:20

.. 14:40 – 15:00 (178) ..

**Automatic consequences of self-instructions – the case of self-generated verbalized expectations.** ROBERT GASCHLER<sup>1</sup>, MAIKE KEMPER<sup>2</sup> & SABINE SCHWAGER<sup>2</sup>; <sup>1</sup>*FernUniversität in Hagen, Germany*; <sup>2</sup>*Humboldt-Universität, Berlin*

Comparing instruction-based automaticity with practice-based automaticity has proven useful to establish instruction-based effects. In this talk we argue that to further specify the boundary conditions and mechanisms underlying instruction-based automaticity it can be useful to explore instruction-like effects. To this end, we report

on a research program on the formation and consequences of self-generated verbalized predictions. Participants were asked to verbalize which stimulus they predict for the upcoming trial. We found that reaction times were faster when the next trial matches (rather than mismatches) the prediction. This difference was more pronounced for self-generated predictions as compared to cues. Self-generated predictions influenced performance even in case of chance-level validity or when they targeted a response-irrelevant stimulus feature. While high validity and response-relevance boosted the effect, the impact was still large (compared to cueing effects) even under adverse circumstances. In addition, the prediction-analogue of the sequential congruency effect was of similar size in conditions varying validity and response relevance of predictions. Frequency variations further strengthened the perspective that making a participant verbalize a prediction imposes automatic effects. Responses were speeded even in the rare case that the infrequent stimulus was predicted and shown in the next trial (while strategic control would have led to predicting and/or preparing the frequent stimulus to optimize performance). We argue that forming and verbalizing a prediction involves representing the potential stimulus in the focus of attention in working memory. Automatic effects of self-generated predictions should be considered as a form of self-instruction effects rather than as effects of expectation per se, as they are similarly found when asking participants to verbalize what they are not expecting / expecting the second most.

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.. 15:00 – 15:20 (179) ..

**From conscious thought to automatic action: A simulation account of action planning.** TORSTEN MARTINY-HUENGER<sup>1</sup>, SARAH E. MARTINY<sup>1</sup>, ELIZABETH J. PARKS-STAMM<sup>2</sup> & PETER M. GOLLWITZER<sup>3,4</sup>, <sup>1</sup>UiT The arctic university of Norway, Norway; <sup>2</sup>Grand Canyon University, USA; <sup>3</sup>New York University, USA; <sup>4</sup>University of Konstanz, Germany

More than 20 years of research on action planning in an if (situation) - then (action) format (i.e., implementation intentions) has provided evidence that such plans increase the likelihood of performing the intended action in the anticipated situation. Furthermore, the initiation of the intended action has been shown to have characteristics that are usually attributed to responses initiated by stimulus-response (S-R) associations (i.e., responses are fast and require minimal effort and no \*in situ\* conscious intention). These characteristics of planning-induced responses are surprising considering that S-R associations are typically formed by actually performing a certain action in a given situation, whereas action initiation following verbal if-then

planning is the result of a single mental act - in the absence of actual actions and plan-relevant perceptions. Based on modern simulation theories of cognition, we will present a theoretical framework explaining how conscious thought (i.e., verbally formulating an if-then action plan) binds motor components of an intended action to an anticipated cue, resulting in subsequent associatively-driven responses. Empirically, we will present six studies providing initial evidence for our simulation account of action planning. We will demonstrate how different if-then action plans link specific movement aspects to critical stimuli - components of a planned physical action that are not included in the verbal reference of the action but would be expected to be included in a full simulation of the action. Subsequently, in an unrelated task, these movement aspects are shown to be reactivated upon encountering the critical stimuli either as targets of a categorization task (Studies 1-4) or as irrelevant distractors primed before categorizing other, unrelated stimuli (Studies 5 & 6). The results and the theoretical framework will be discussed within the symposium's general topic of "instruction-based automaticity."

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.. 15:20 – 15:40 (180) ..

**The role of working memory in rapid instructed task learning and intention-based reflexivity: An individual differences examination.** NACHSHON MEIRAN, MAAYAN PEREG, ELLA GIVON, GAL DANIELI & NITZAN SHAHAR; Ben-Gurion University of the Negev, Israel

The ability to efficiently follow novel task instructions (Rapid Instructed Task Learning, RITL) appears late in evolution, is required for successful collaborative team work, and appears to involve maintaining instructions in working-memory (WM). RITL is indexed by the efficiency in which the instructions are performed (RITL success) and by whether the instructions operate automatically (intention-based reflexivity). Based on prior normative work employing WM-load manipulations, we predicted that individual differences in WM would positively correlate with these RITL indices. Participants (N=175) performed the NEXT paradigm, which is used to assess RITL, and tests of choice reaction time, intelligence, and WM. Confirmatory factor analyses showed that, contrary to our predictions, successful performance in WM tasks did not predict RITL performance. Tests tapping general-fluid intelligence and reaction time positively correlated with RITL success. However, contrary to our predictions, RITL success positively correlated with little intention-based reflexivity. We suggest that for a RITL paradigm to produce intention-based reflexivity, its WM demand must

be low, and, thus, performance does not reflect individual differences in WM.

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.. 15:40 – 16:00 (181) ..

**The role of motor imagery in learning via instructions.** BAPTIST LIEFOOGHE, MARIJKE THEEUWES, MAARTEN DE SCHRYVER & JAN DE HOUWER; *Ghent University, Belgium*

Learning via instructions and learning through physical practice are complementary pathways to obtain skilled performance. Whereas an initial task representation can be formed on the basis of instructions, physically practicing novel instructions leads to a shift in processing mode from controlled processing toward more automatic processing. This shift in processing mode is supposedly caused by the formation of a pragmatic task representation, which includes task parameters needed to attain skilled task execution. In between learning via instructions and physical practice, a third type of learning can be situated, motor imagery. Two experiments are reported that studied the extent to which motor imagery can enhance the application of novel instructions. A procedure was developed in which performance improvement after motor imagery could be measured for behavioral markers of processes underlying response selection (i.e., initiation time of a response sequence) and for behavioral markers of processes underlying movement execution (i.e., completion time of the response sequence). Our results suggest that whereas physical practice improves response selection and movement execution, motor imagery only improves response selection. We propose that motor imagery also leads to a shift in processing mode and to the formation of a pragmatic task representation, albeit a less detailed one as compared to the representation that is formed on the basis of physical practice.

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.. 16:00 – 16:20 (182) ..

**Top-down control over execution-based and verbal code-based S-R associations.** CHRISTINA PFEUFFER<sup>1</sup>, KAROLINA MOUTSOPOULOU<sup>2</sup>, FLORIAN WASZAK<sup>2</sup> & ANDREA KIESEL<sup>1</sup>; <sup>1</sup>*University of Freiburg, Germany*; <sup>2</sup>*Université Paris Descartes, France*

According to recent studies, two independent components of stimulus-response (S-R) associations, Stimulus-Action (S-A) and Stimulus-Classification (S-C) associations, cannot only be established by active task execution, but also by passively attending to verbal codes denoting action and classification. Here, we explored whether the retrieval effects of S-A and S-C associations were modulated by the overall rate at which S-A

and S-C mappings switched or repeated between an item-specific encoding (prime) and retrieval instance (probe). Stimuli were presented once as a prime and once as a probe and we assessed performance differences between trials in which mappings item-specifically repeated versus switched between prime and probe (i.e., item-specific switch costs). In two experiments, we systematically manipulated the overall proportion of item-specific switches in S-A and S-C mapping. We found that S-A/S-C switch proportion affected the size of the corresponding S-A/S-C switch costs: Switch costs were reduced when the corresponding item-specific mapping switches were frequent rather than infrequent. Crucially, this pattern of results emerged both for S-R associations formed based on active task execution and based on passively attending to verbal codes. These findings indicate that, independent of whether S-R associations were formed in the presence or absence of action, the encoding and/or retrieval of S-R associations was regulated by top-down control processes. This modulation of S-R retrieval effects by the overall proportion of item-specific S-R mapping switches bears a strong similarity to the modulation of congruency effects like the flanker congruency effect by congruency proportion.

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## Symposium: Mixed-effects Models in Cognitive Psychology H8, Tuesday, 14:40 – 16:20

.. 14:40 – 15:00 (183) ..

**The generalized additive mixed model by example.** HARALD BAAEN; *University of Tuebingen, Germany*

Compared to the linear mixed-effects model, the generalized additive mixed model, as implemented in Simon Wood's mgcv package for R, offers the analyst many advantages, including (i) splines (instead of polynomials) for nonlinear effects of covariates, (ii) tensor product smooths for interactions of covariates, (iii) the possibility of including nonlinear random effects by means of factor smooths, (iv) the possibility of using the scaled t-distribution family for the case where model residuals follow a t-distribution instead of a normal distribution, (v) the possibility to model ordinal responses or the survival function with all the functionality of smooths and (multiple) random effect factors, (vi) to examine quantiles rather than the mean, and (vii) to reduce autocorrelations in

the errors. These advantages will be introduced by example, including grammaticality judgements on a Likert scale, tongue movements during articulation as registered by electromagnetic articulography, and reaction times in visual lexical decision.

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.. 15:00 – 15:20 (184) ..

#### **Why fit Bayesian linear mixed models? And how?**

SHRAVAN VASISHTH; *Potsdam, Germany*

Linear mixed models have become a standard tool for analysing repeated measures data. Especially with the arrival of the lme4 package by Douglas Bates, fitting such models amounts to writing a single line of code in R. Despite this convenience, since 2012, I have been mainly fitting Bayesian linear mixed models using a much more tedious procedure involving the probabilistic programming languages JAGS and Stan (Sorensen, Hohenstein, and Vasishth, 2016). In this talk, I will explain what the gain is over frequentist modelling. Briefly, the advantages are: more flexible model specification (for example, defining finite mixture models or shifted lognormal models is trivial; see Nicenboim and Vasishth 2017), an ability to directly answer the research question instead of rejecting a strawman null (Vasishth and Gelman 2017, Logachev and Vasishth 2016, Nicenboim and Vasishth 2016), and a much better understanding of the underlying generative process assumed when fitting linear mixed models (Nicenboim and Vasishth 2017). During the 10 years that I spent publishing papers after fitting frequentist linear mixed models, I successfully avoided knowing anything about the underlying variance covariance matrices assumed in the random effects structure. And successfully avoided caring about whether model assumptions were met; all I ever cared about was whether  $p$  was less than 0.05. I did not care whether the model made any sense or even if it had any bearing with reality. The strategy was successful in that I became a full professor, but it wasn't successful in helping me understand whether I had answered my research question or not (Jäger, Engelmann and Vasishth, 2017). Bayesian modelling has helped me greatly in this respect.

I will show how one can easily fit fairly complex models using the probabilistic programming language, Stan (Nicenboim and Vasishth 2016, Sorensen, Hohenstein, and Vasishth, 2016).

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.. 15:20 – 15:40 (185) ..

#### **Linked Linear Mixed Models.** REINHOLD KIEGL; *University of Potsdam, Germany*

Current practice in the analysis of eye-movement control during reading is to carry out independent analyses of several dependent variables despite uncontroversial evidence of their correlation. Two examples are (a) the correlation between fixation locations and their associated durations and (b) the correlation between successive fixation durations. Linked linear mixed models (LLMMs; Hohenstein et al., 2016, PsychBullRev) are one option to address this issue and, aside from a methodological advance, focus the analysis on the local dynamics of eye-movement control. The method is illustrated with two examples. First, LLMMs of eye movements from reading simplified and traditional Chinese sentences are used to illustrate how perceptual and lexical properties of neighboring words influence fixation location and how these effects carry through to the associated fixation durations, in agreement with results reported for reading of German sentences. Second, LLMMs allow a simultaneous analysis of the dependencies between pre-boundary and post-boundary fixation durations in the boundary paradigm (Rayner, 1975, CogPsych). LLMMs hold promise for overcoming a methodological weakness of current statistical practice and at the same time contribute to theoretical advances in understanding the dynamics of distributed processing in the perceptual span during reading of sentences.

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.. 15:40 – 16:00 (186) ..

#### **Understanding predictability with Linear Mixed Models and cluster-based permutation test.**

BRUNO BIANCHI<sup>1</sup>, DIEGO E SHALOM<sup>2</sup>, DIEGO E SHALOM<sup>3</sup> & JUAN E KAMIENKOWSKI<sup>1</sup>; <sup>1</sup>Laboratorio de Inteligencia Artificial Aplicada, Instituto de Ciencias de la Computación, CONICET-UBA; <sup>2</sup>Departamento de Física, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires and IFIBA, CONICET, Ciudad Universitaria, Buenos Aires 1428, Argentina; <sup>3</sup>Departamento de Física, FCEyN, UBA and IFIBA, Conicet, Pabellón 1, Ciudad Universitaria, 1428 Buenos Aires, Argentina

As in almost every daily visual task, the brain generates a prediction on the forthcoming stimuli. In reading, this prediction is usually operationalized as the Predictability, i.e. the probability of knowing a future word before reading it. These predictions could be built on different factors depending on the stimuli, such as syntactic, semantic, phonological relations with the context or even memory retrieval of known sentences.

In the present study, we aimed to separate the memory encoded contribution to the predictability

using proverbs and common sentences on a Serial Visual Presentation EEG experiment. The data was first analyzed on a classical ERP analysis, finding the well described N400 effect for predictability, but without a robust effect of the sentence type. We attribute this lack of effect to the average, where the proverbs' words are taken all together. In order to overcome this issue (and also the lack of control over the other covariables), we implemented a Linear Mixed Models (LMM) for each sample (electrode and time-point). Although, this type of analysis comes with a cost: it implies to run a lot of models. Thus, we corrected for multiple comparisons and extracted global statistical measures by embedding the LMMs results for each sample in a cluster-based permutation approach. Since the current literature on cluster-based permutation procedures [Maris and Oostenveld, 2007] is based on univariate statistical tests we explored different possibilities for the implementation of permutations for our multivariate data.

Using this procedure we observed the classical predictability effect (N400), a conspicuous late effect of the word position in sentence and an interaction effect of the sentence type (proverb vs non-proverb) with the predictability, which clearly supported a classical N400 effect for the common sentences, and no effect for the proverbs, suggesting differences in prediction mechanisms.

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the ink color of color words in 30 abbreviated lists of 18 trials. Trials were congruent (e.g., RED in red ink) or incongruent (e.g., BLUE in red ink). Experience within the early segment of the list (first six trials) was manipulated to encourage adoption of a broader (mostly congruent condition) or narrower (mostly incongruent condition) attentional setting. In contrast, the middle and late list segments were always 50% congruent.

Results: In the early list segment, the Stroop effect was reduced in the mostly incongruent condition compared to the mostly congruent condition. Shifting of control settings occurred rapidly as indicated by the increase in the Stroop effect from the early to the middle list segment for lists that were initially mostly incongruent and the decrease for those that were initially mostly congruent. By the end of the list, Stroop effects were equivalent across conditions. There were no age differences in these patterns.

Discussion: Older adults initially acquired distinct attentional settings based on early experience and flexibly shifted and updated these settings as rapidly as young adults in response to changing experience. This suggests there may be age-equivalence in these processes when experience is behind the wheel. In follow-up research, we explored the generality and moderators of experience-driven adjustments in control in young and older adults.

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.. 16:55 – 17:15 (188) ..

## Symposium: Cognitive Control in Aging

H1, Tuesday, 16:35 – 18:15

.. 16:35 – 16:55 (187) ..

**The flexibility of cognitive control: Age equivalence when experience is behind the wheel?** JULIE M BUGG, EMILY R COHEN-SHIKORA, NATHANIEL T DIEDE & CHELSEA S BIRCHMIR; *Washington University in St. Louis, United States of America*

Background: Older adults often are less effective than young adults in maintaining an attentional bias in favor of goal-relevant information and less flexible in updating and shifting goals. Using a novel variant of the Stroop task, we tested the hypothesis that age-related differences in cognitive control may not be robust when the flexible maintenance and updating of attentional settings is guided by task experience rather than top-down intentions.

Method: Young adult college students (N = 30) and older adults 60 years and older (N = 30) named

**Demands on working memory and the positivity bias in feedback processing in old age.** NICOLA KRISTINA FERDINAND; *Universität des Saarlandes, Germany*

Evaluating feedback from the environment is important to flexibly adapt our behavior. In this study, we applied an event-related potential (ERP) approach to examine the influence of increased working memory load on younger and older adults' ability to process feedback. We used a probabilistic learning task in which participants learned the assignment of pictures to responses. In the low load version of this task, participants had to learn one (out of two possible) correct response to a picture. In the high load version, two (out of four possible) correct responses to a picture had to be learned. Feedback processing was measured by means of the Feedback-Related Negativity (FRN), which is usually elicited in the ERP after unexpected negative feedback, and the P300, which reflects working memory updating after unexpected events. Our results show that in the high load version of the task, older adults process positive feedback more strongly than negative feedback as is evident in the FRN. In general, older adults

show a frontal shift in the P300 probably reflecting increased frontal recruitment. However, in the high load version of the task, younger adults' result pattern becomes very similar to that of older adults': P300 after positive feedback is more pronounced and a frontal shift in the P300 becomes evident. This implies that at least some aspects of age-related changes in feedback processing might be due to impaired working memory.

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.. 17:15 – 17:35 (189) ..

**The role of cognitive control in age-related prospective memory.** KATHARINA MARLENE SCHNITZSPAHN<sup>1</sup>, NICOLA BALLHAUSEN<sup>2</sup> & MATTHIAS KLIEGEL<sup>2</sup>; <sup>1</sup>University of Aberdeen, United Kingdom; <sup>2</sup>University of Geneva, Switzerland

#### Background

Prospective memory (PM) describes the cognitive processes needed to successfully fulfill delayed intentions. One key process involved is cognitive control. However, the exact role of cognitive control for PM in general and for explaining age differences in particular remains poorly understood. The goal of the present research was therefore to examine how cognitive control demands influence PM in young and older adults by experimentally manipulating different task characteristics based on current theoretical suggestions.

#### Method

Three separate studies testing overall more than 250 young and 230 older adults assessed PM in the laboratory using a similar paradigm. In each study, task difficulty and thereby the required amount of cognitive control was varied within participants by manipulating: 1) cue salience, 2) the association between cue and action, 3) ongoing task demands.

#### Results

All studies show clear age differences suggesting a general PM age decline. Further, task effects were observed in all studies showing that the difficulty manipulation was successful and highlighting the importance of cognitive control processes for PM in general. Age x task difficulty interactions emerged only for cue salience and ongoing task demand. Older adults' PM suffered particularly when a difficult ongoing task was used, while young adults' performance profited significantly from salient cues.

#### Discussion

In sum, the present results underline that PM requires cognitive control and performance therefore declines when a task posing high control demands is used. Given the general cognitive decline usually accompanying aging, which is also reflected in the general PM age deficit observed in the present studies, one could have expected pronounced age differences in all difficult task conditions. However,

older adults do not suffer more than young adults from low associations between PM cue and action and profit less from salient cues. The present results are discussed concerning their theoretical and practical meaning.

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.. 17:35 – 17:55 (190) ..

**Executive control training in patients with chronic heart failure.** JULIA KARBACH<sup>1</sup>, SONJA WEDEGÄRTNER<sup>2</sup>, BENEDIKT BERNHARD<sup>2</sup> & INGRID KINDERMANN<sup>2</sup>; <sup>1</sup>University of Koblenz-Landau, Germany; <sup>2</sup>Saarland University Hospital, Homburg, Germany

**Background:** Patients suffering from chronic Heart Failure (HF) show cognitive impairments that are associated with numerous adverse effects, such as a higher mortality rate, worse quality of life, poorer drug adherence and more frequent hospitalization. Compared to healthy controls, the cognitive impairment in HF patients is most pronounced in terms of executive functions, attention and processing speed. At the same time, recent studies showed that especially executive functions (working memory, inhibition, cognitive flexibility) could be improved by training in healthy subjects. Importantly, these improvements transferred to new, untrained tasks and related abilities. So far, it is unclear whether HF patients benefit from cognitive training. Therefore, the aim of this study was to investigate the effect of computer-based adaptive training on cognitive functions and well-being in patients with stable chronic HF.

**Method:** The training regime tapped verbal working memory, visuospatial working memory, and cognitive flexibility (6 sessions). Before and after training, participants performed a neurocognitive battery to test for transfer effects and completed a number of self-report questionnaires assessing well-being and cognitive performance in daily life. We compared three groups (mean age=65.3 years, SD=10.4): the experimental group performing the cognitive training (n=25), an active control group spending the same amount of time on general knowledge quizzes (n=25), and a passive control group (n=20).

**Results:** We found significant training gains on all training tasks (verbal working memory, visuospatial working memory, and cognitive flexibility). Moreover, the training benefitted visuospatial short-term and working memory and patients in the experimental group reported less cognitive failures in daily life after they completed the training.

**Discussion:** Our findings show substantial cognitive plasticity in HF patients, particularly in domains that are significantly impaired in this population. They highlight the potential relevance of

cognitive training in the treatment of patients suffering from chronic HF.

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## Symposium: Current Developments in Task-switching Research

H2, Tuesday, 16:35 – 18:15

.. 16:35 – 16:55 (191) ..

**A multidisciplinary approach to task switching: an integrative view from information theory and cognitive brain potentials.** FRANCISCO BARCELÓ<sup>1</sup> & PATRICK S. COOPER<sup>2,3</sup>; <sup>1</sup>Laboratory of Neuropsychology, University of the Balearic Islands, Mallorca, Spain; <sup>2</sup>Functional Neuroimaging Laboratory, School of Psychology, University of Newcastle, Callaghan, Australia; <sup>3</sup>Priority Research Centre for Brain and Mental Health, University of Newcastle, Callaghan, Australia

Background. Modern enactivist views posit that cognition subserves action. If this is so, then more or less contextual (i.e., temporal, task) uncertainty about actions should result in more or less efficient control – i.e., costs in speed and accuracy – of task-switching, as well as in simpler task domains. Method. In order to examine this hypothesis, behavioral and brain responses were recorded while participants were intermittently cued to switch or repeat their categorization of Gabor gratings varying in color and thickness (switch task), or else they performed two visually identical control tasks (go/nogo and oddball) albeit with different motor response and cognitive demands each. The electroencephalogram (EEG) was analyzed for both sustained oscillatory power changes and transient event-related brain potentials (ERPs). A simple information theory model helped us formalize temporal and task uncertainty in terms of sensory, motor, as well as low- and high-order sensorimotor (i.e., rule updating) variables. Results. Behavioral costs ensuing transition cues in the switch task yielded both domain-general (restart, mixing) and switch-specific (local) costs. Scalp topographies of transient ERP switch positivities showed split-second modulations as a function of temporal (unpredictable vs. predictable gratings) and task uncertainty, over and above the stimulus context alone. Functionally distinct fronto-parietal switch positivities were elicited both proactively and reactively by cues and first target trials, respectively (as plausible neural proxies of local and restart costs). Instead, mixing costs were best captured by sustained power changes in delta (2-4 Hz) and

theta (4-7 Hz) EEG oscillations. Discussion. Findings partly met information theory estimates, and supported a hierarchy of both domain-general and switch-specific control operations compatible with dual modes models of cognition that postulate distinct mechanisms during proactive (exploratory) and reactive (exploitative) control of task-switching behavior.

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.. 16:55 – 17:15 (192) ..

**What role for inhibition in task switching?** JAMES A. GRANGE; *Keele University, United Kingdom*

The task switching paradigm is an incredibly popular tool with which to measure cognitive control processes thought to allow the cognitive system to flexibly respond to dynamic environments. One control process thought to aid efficient task switching is the inhibition of recently-performed tasks. Evidence for inhibition in task switching comes from the n-2 task repetition cost: The finding of poorer performance (response times and accuracy) for ABA task switching sequences compared to CBA sequences. This is thought to reflect the persisting inhibition of task A, which hinders reactivation attempts. Our lab has recently provided evidence that this n-2 repetition cost is strongly modulated by episodic retrieval (Grange et al., 2017, JEP:HPP), which can create interference during task performance. When we control for this episodic interference, the residual n-2 task repetition cost is small and sometimes non-significant. The current talk will provide an overview of the utility of using the n-2 task repetition cost to measure inhibition in task switching in basic and applied research.

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.. 17:15 – 17:35 (193) ..

**How effective are preparatory switches of attention?** AURELIU LAVRIC; *University of Exeter, United Kingdom*

One component of task-set (S-R rules) has traditionally received intense scrutiny. Indeed, theoretical accounts of the task ‘switch cost’ have attributed it to conflict between competing sets of S-R rules. However, recent studies (e.g., Elchlepp, Best, Lavric, & Monsell, 2017) show that when a task switch involves shifting attention from one perceptual attribute (location, dimension) to another, such shifts can account for a substantial part (a third, half, or even more) of the performance switch cost, because of a tendency to attend to the no longer relevant attribute – ‘attentional inertia’, which is surprisingly hard to eliminate even with ample opportunity for preparation. The effectiveness of shifting attention in advance of the stimulus seems to

vary considerably depending on type of attention. It seems that preparation can eliminate the cost of switching between the visual and auditory modalities. Under certain conditions, preparation can also eliminate the cost of shifting visual attention among locations. But, preparation does not seem to eliminate the cost of shifting attention between visual dimensions such as colour vs. form. Preparing to shift attention from an emotional face to a superimposed letter does little to attenuate the effect of emotional expression. The cost of a change in the target voice in a multi-speaker ("cocktail party") set-up is large even following advance warning of the target voice. Intriguingly, familiarity with the voices does not reduce this 'voice switch cost', but exposure during preparation to the target and non-target voices (simultaneously uttering a task-irrelevant word) dramatically reduces the switch cost. This suggests that having some perceptual input to which to apply the newly (re)configured attentional settings may be key to effective preparatory attention.

Elchlepp H., Best, M., Lavric A., & Monsell S. (2017). Shifting attention between visual dimensions as a source of the task-switch cost. *Psychological Science*, 28, 470-481.

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.. 17:35 – 17:55 (194) ..

**Diffusion modeling of task-switching performance: Strengths and limitations.** STEFANIE SCHUCH; *RWTH Aachen University, Germany*

While originally developed for single-task paradigms, the diffusion model has recently been applied to task-switching paradigms, aiming to better understand the cognitive processes underlying task-switching performance. Standard task-switch costs (i.e., the performance difference between task switches and repetitions) are usually reflected in several diffusion model parameters, suggesting that different cognitive processes contribute to this overall cost. Another empirical task-switching effect, called N-2 task repetition cost (i.e., the performance difference between task sequences of types ABA and CBA), is only reflected in one diffusion model parameter (drift rate), suggesting that this cost reflects processes during response selection, rather than processes of task preparation or motor execution. Still another empirical effect in task switching are response-repetition costs (i.e., the performance difference between response repetitions and switches), for which diffusion modeling reveals several cognitive processes to be involved. These examples demonstrate that diffusion modeling can be a useful tool for task-switching researchers. Yet, there are also important limitations; for instance, it is difficult to distinguish pre-decisional processes of task preparation from post-decisional

processes of response execution within the standard diffusion model. Perspectives for future research strategies will be discussed.

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.. 17:55 – 18:15 (195) ..

**The science of perseveration: Insights from a novel task-switching/card-sorting paradigm.** BRUNO KOPP<sup>1</sup>, ALEXANDER STEINKE<sup>1</sup>, NACHSHON MEIRAN<sup>2</sup>, CAROLINE SEER<sup>1</sup> & FLORIAN LANGE<sup>1</sup>; <sup>1</sup>*Medical School Hannover, Germany*; <sup>2</sup>*Ben-Gurion University of the Negev, Israel*

Background: Excessive perseverative tendencies are pervasive in many areas of psychology. We analyzed switch costs in a novel cued task-switching/card-sorting paradigm that facilitates integrating basic and clinical research on perseverative behavior. We reasoned that interference from previously active task sets may be contingent upon the retrieval of these sets via stimulus processing (stimulus-set binding) or response processing (response-set binding). Method: We examined the efficacy of these two factors through eligibility manipulations. That is, stimulus/response features that were capable to retrieve task sets from previous trials remained eligible (or not) on current trials. Results: We report two main findings from a large study (N = 95): We found that stimulus-set binding, and of importance response-set binding, both contributed roughly equivalently to switch costs. Evidence for stimulus-set binding was exclusively observed when previously executed responses remained ineligible. Discussion: Possible interpretations of non-additive switch costs are discussed.

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## Symposium: Symbolic or Grounded? Abstract meaning in the human mind and brain - Part II

H5, Tuesday, 16:35 – 18:15

.. 16:35 – 16:55 (196) ..

**Individual differences reveal the embodied nature of language comprehension.** ART GLENBERG; *Arizona State University, -*

Mahon (2015) proposes that language and cognition can be understood using amodal symbolic processes. He claims that "it is the independence of thought from perception and action that makes human cognition special." I will address this claim



in two ways. First, I use Pulvermüller's connectionist model (e.g., Pulvermüller, 2013) to demonstrate that the evidence he cites is perfectly consistent with an embodied account of language comprehension. Second, I discuss two individual differences research projects to show the power of the embodied approach and to raise new challenges for the amodal symbol account of language comprehension. In the first project, we show that activity in motor cortex during verb comprehension predicts general language comprehension as measured by the Gates-MacGinitie reading test. That is, the degree to which one engages in motor simulation predicts general reading comprehension. In the second project, we teach children to engage in motor simulation while listening to stories. We find that changes in language comprehension from pre- to post-intervention are strongly correlated with the changes in motor cortex activity while listening. Neither of these findings is anticipated by an amodal symbol account.

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.. 16:55 – 17:15 (197) ..

**What sort of brain could build on the understanding that a cup is like a doughnut to develop a category-theoretic approach to program semantics?** MICHAEL A. ARBIB; *California Institute of Technology & University of California, San Diego, United States of America*

The question "What sort of brain could build on the understanding that a cup is like a doughnut to develop a category-theoretic approach to program semantics?" is itself an example of a sentence whose meaning is not only highly abstract but dependent on knowledge that only a few specialists would possess. The aim of the talk will be to examine some of the knowledge needed to understand the question as the basis for pointing toward possible future research that might answer the question. The path for a human TOWARDS understanding the question is grounded in experience as an embodied, social human being, but – in the spirit of Wittgenstein's ladder – it is debatable whether the meaning as such of the question is itself dependent on either that grounding or on the nature of the human body.

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.. 17:15 – 17:35 (198) ..

**Concrete Mechanisms For Abstract Meaning.** FRIEDEMANN PULVERMÜLLER; *Freie Universität Berlin, Germany*

The human brain can process abstract meaning. Word such as "love", "peace" and "not" can be understood without problems and even the abstract sense of concrete word sequences can be easily grasped ("She caught the sun"). However,

whereas some concrete neuronal mechanisms have been offered for concrete word understanding, few such descriptions are available for aspects of abstract meaning. Accounts in terms of abstract semantic features seem to fail, because abstract meaning is 'explained' by abstract semantic features and it remains unclear how the latter are explainable. Distributional word co-occurrence approaches can map the degree of semantic relationship between symbols, but do not clarify the mechanisms for grasping abstract concepts. This talk will focus on typical examples of abstract symbolic meaning and ask whether established neuroscience principles of correlation learning can contribute to their explanation and learning. Examples will range from abstract emotion words such as "joy" and "love", which have their natural expression in bodily action and in patterns of social-interactive behaviour, to abstract object- ("beauty") and action-related concepts ("to free"). Logical semantic concepts, such as negation and conjunction, will also be addressed. Instead of abstract statements, concrete neuronal circuit solutions will be offered for different abstraction mechanisms. The proposed mechanisms for the "brain embodiment" of abstract meaning will be contrasted with one version of a classic symbolic model of concepts. The obvious conclusion is that the latter may profit from some concretisation and the former offer a pathway towards better understanding and indeed explanation of conceptual abstraction – although only experimental data can prove them right or wrong.

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## Symposium: Introspective Experiences and Adaptive Behavior H6, Tuesday, 16:35 – 18:15

.. 16:35 – 16:55 (199) ..

**Subjective experience of difficulty depends on multiple cues.** KOBE DESENDER<sup>1</sup>, FILIP VAN OPSTAL<sup>2</sup> & EVA VAN DEN BUSSCHE<sup>1</sup>; <sup>1</sup>Vrije Universiteit Brussel, Belgium; <sup>2</sup>University of Amsterdam, The Netherlands

Human cognition is characterized by subjective experiences that go along with our actions, but the nature and stability of these experiences remain largely unclear. In the current report, the subjective experience of difficulty is studied and it is proposed that this experience is constructed by integrating information from multiple cues. Such an account can explain the tight relationship between primary

task performance and subjective difficulty, while allowing for dissociations between both to occur. Confirming this hypothesis, response conflict, reaction time and response repetition were identified as variables that contribute to the experience of difficulty. Trials that were congruent, fast or required the same response as the previous trial were more frequently rated as easy than trials that were incongruent, slow or required a different response as the previous trial. Furthermore, in line with theoretical accounts that relate metacognition to learning, a three day training procedure showed that the influence of these variables on subjective difficulty judgments can be changed. Results of the current study are discussed in relation to work on meta-memory and to recent theoretical advancements in the understanding of subjective confidence.

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.. 16:55 – 17:15 (200) ..

**Building Blocks of Metacognitive Experiences in Conflict Tasks.** LAURENCE QUESTIENNE<sup>1</sup>, ATAS ANNE<sup>1</sup>, BORIS BURLE<sup>2</sup> & WIM GEVERS<sup>1</sup>; <sup>1</sup>*Center for Research in Cognition and Neurosciences (CRCN) –ULB Neurosciences Institute (UNI), Université Libre de Bruxelles (ULB), Brussels, Belgium;* <sup>2</sup>*Aix-Marseille Université, CNRS, LNC UMR 7291, Laboratoire de Neurosciences Cognitives, Marseille, France*

Humans are able to subjectively evaluate their own actions. Different features can be used to create such metacognitive appraisals. In conflict tasks, they can result from different inter-related features. In the current study, we investigated how the reported urge-to-err in a conflict task depends on contribution of three different features: reaction time duration, response fluency (with or without response competition), and visual congruency. This is not a simple task because these features are partly confounded (e.g. incongruent trials result in slower RT, higher response competition and lower fluency). Therefore, an objective measure of each feature separately was required. Visual congruency is entirely determined by trial type. RT distribution analysis allows assessing the impact of RT on urge-to-err. Response fluency with or without competition, in contrast, cannot be objectified solely on behavioral measures. However, recording the electromyographic (EMG) activity of the muscles involved in response execution is powerful in revealing response fluency with or without response competition. By combining behavioral and electromyographic measures, we were able to disentangle the contribution of each feature to the subjective experience of urge-to-err. Both reaction time and response fluency with response competition were shown to be major determinants of metacognitive appraisals. Importantly, decreased response fluency without response competition and visual

congruency had only a limited influence. The current study shows that subjective experiences of urge-to-err result from several features that can be objectified and disentangled. More broadly, it opens perspectives for the investigation of metacognition and introspection in general. First, this work provides tools to achieve a fine-grained description of subjective experiences. Second, the current study underlines the reliability of introspection by relating introspective reports to objective measures. In other words, the current study shows that subjectivity can be objectified.

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.. 17:15 – 17:35 (201) ..

**Conflicts as aversive signals: The functional role of the subjective conflict experience for control adaptations.** GESINE DREISBACH<sup>1</sup> & RICO FISCHER<sup>2</sup>; <sup>1</sup>*Universität Regensburg, Germany;* <sup>2</sup>*Universität Greifswald*

Human beings have an astonishing ability to adjust actions and thoughts to changing task demands and context conditions. Especially the role of conflict signals has been highlighted as trigger condition for control adjustments and behavioral adaptation. Recently, the interest in control adjustments has shifted from more mechanistic questions (the specificity of the adaptation process, or the share of associative learning and episodic retrieval) to questions about what role subjective influences (conflict experience, affect, and reward) may play for control adaptations. The talk will give a short overview on recent research showing that conflicts are experienced as aversive. The critical question, however, whether this aversive signal originally motivates control adaptation or whether it merely occurs as an epiphenomenon of the subjective conflict experience is still subject to debate. I will therefore present current research from our labs where we manipulated the experienced aversiveness of the conflict signal in order to investigate its impact on control adaptations. The results provide at least indirect support for a functional role of the aversive conflict signal. Issues associated with the manipulation and measurement of the subjective conflict experience will be discussed.

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.. 17:35 – 17:55 (202) ..

**Introspection as decision.** JÉRÔME SACKUR; *École des Hautes Études en Sciences Sociales, France*

An increasing number of studies in cognitive science make use of introspective responses. These responses are used as valid markers of subjective states, but, with the notable exception of confidence judgments, their generative mechanisms are left mostly unexplored. Here, drawing on two

set of studies, I will make the case that the general framework of signal detection theory applies to introspections, as it applies to perceptions. First, I will present behavioral and pupillometric data from mind-wandering experiments suggesting that when participants are asked to report whether they are on-task or mind-wandering, they do so by comparing the level of an internal state variable with an adjustable criterion. Mental monitoring of mind-wandering thus exhibits a fundamental signature of signal detection. Second, I will focus on self-estimation of response times, as a specific case of self-observation. While it is known that participants can, with some limitations, report the speed of their own decisions, we don't know how this is achieved. Here, by means of modeling of response times in the sequential sampling framework, I will show that the psychometric properties of these second order self-observations are similar to those of first order decisions. Together, these findings converge on the notion that mental monitoring and self-observation can be modeled as inner or second order decisions. I will discuss the implications with respect to the functional significance of introspection.

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## Symposium: Accents and Dialects

### H8, Tuesday, 16:35 – 18:15

.. 16:35 – 16:55 (203) ..

**Does exposure to dialect variation help or hinder literacy acquisition?** GLENN PATRICK WILLIAMS, NIKOLAY PANAYOTOV & VERA KEMPE; *Abertay University, Dundee, United Kingdom*

Educational practitioners disagree on how to handle dialect-induced phonetic variation in literacy instruction, as it is unclear whether dialect exposure hinders literacy acquisition. In children using non-mainstream American English, dialect use is often associated with impaired literacy acquisition in general, and lower reading performance in contrastive words, i.e. words that differ between varieties, in particular. However, dialect use is also linked to differences in socio-economic status, which affects quality and amount of educational opportunities. To control for such confounds, we employed a miniature artificial literacy learning paradigm with a between-participants dialect exposure manipulation, using an invented script containing 13 graphemes paired with eight consonants and five vowels in a transparent way. Following results from connectionist simulations, we pre-

dicted impaired reading performance for contrastive words in the dialect condition.

Participants were pre-trained on 30 artificial words and individual grapheme-phoneme mappings. In three training blocks of ten items each, participants practiced reading and spelling, interspersed with further exposure to the entire training set. In the dialect condition, half of these words were presented as dialect variants, mimicking a situation of dialect exposure at home and standard exposure at school. Participants were then tested on standard trained and novel words. Reading and spelling performance, measured as proportion of correct responses, and as normalised edit distance, improved over the course of training. Unexpectedly, during training, naming and spelling responses deviated less from the targets in the dialect compared to the standard condition. During testing, performance was higher for trained words, and, as predicted, naming responses for contrastive (vs. non-contrastive) words deviated more from targets in the dialect condition only. These results suggest that dialect variants introduce competing forms thereby impairing direct lexical access, which can be compensated for by increased attention to grapheme-phoneme conversion rules resulting in a dialect boost for sufficiently transparent orthographies.

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.. 16:55 – 17:15 (204) ..

**Cross-dialect lexical accommodation: Socially motivated or automatic priming?** ALISSA MELINGER & CONOR ROSS; *University of Dundee, United Kingdom*

Bidialectal speakers, namely people who speak multiple regional dialects, must choose words that are appropriate to their social situation. For example, in the US a speaker might ask about an 'elevator' but when in the UK they should ask for the 'lift'. The aim of this study is to assess how this socially-constrained lexical selection process is achieved. Specifically, we investigate the influence of sociolinguistic context and prior exposure on the activation and selection of dialectal alternatives.

We developed a novel variant of a classic referential communication task (Glucksberg, Krauss, & Weisberg, 1966) consisting of 89 images, 15 with non-cognate dialectal alternative labels. To manipulate prior exposure, we paired 40 British participants with either a British or American (pre-recorded sham) confederate. In the first phase of testing, participants arranged pictures according to instructions by the confederate; The American confederate used American dialect alternatives and the British confederate used British dialect alternatives. To manipulate the social context, in the second phase, a new American or British confeder-

ate was introduced and the participant took up the director's role, naming objects for the confederate.

Focusing on British participants producing their preferred British labels, we compared picture naming times and lexical selection outcomes across the four confederate conditions. Participants produced the preferred British picture labels significantly slower and less often when they had been previously exposed to the American alternative label. This effect was not modulated by the sociolinguistic context. In other words, participants' response times and lexical choices were not affected by the listener's dialect. The results suggest that prior exposure to a dialect alternative will strengthen subsequent lexical competition effects but a sociolinguistic context, by itself, will not boost the availability of dialect-appropriate lexical items. The results will be discussed in the context of codeability effects and bilingual lexical selection.

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.. 17:15 – 17:35 (205) ..

**The impact of accent exposure in a word learning task.** CLAIRE DELLE LUCHE<sup>1</sup>, SAMANTHA DURRANT<sup>2</sup>, PAUL RATNAGE<sup>3</sup> & CAROLINE FLOCCIA<sup>3</sup>; <sup>1</sup>University of Essex, United Kingdom; <sup>2</sup>University of Liverpool, United Kingdom; <sup>3</sup>Plymouth University, United Kingdom

Monolingual toddlers use Mutual Exclusivity to identify the referent of a novel word from 17 months old (Halberda, 2003). Bilinguals, however, demonstrate use of this strategy later, from 24 months and only in specific circumstance while it seems trilinguals do not use it at all (Byers-Heinlein & Werker, 2009). The underlying argument is that Mutual Exclusivity relies on the assumption that objects have a single label: this does not hold for multilingual toddlers for whom each object has a name in each of the languages they are learning.

A sub-category of monolingual toddlers that have been likened to bilinguals are those hearing at least 2 dialect variants of a single language. Indeed, differences have been identified between monodialectal and multidialectal populations in terms of familiar word recognition (Durrant et al., 2014). This study explores the idea that dialect variation may influence Mutual Exclusivity use in multidialectal toddlers.

Following Halberda (2003) 18, 21, and 24 month old monodialectal and multidialectal toddlers saw pairs of images split across three trial types, Known-Known, Known-Unknown and Unknown-Known. Mutual Exclusivity can be exploited to map the novel label to the novel object in the Unknown-Known trials only.

None of the 48 18 month olds showed evidence of using Mutual Exclusivity (Unknown-Known trials:  $t(46)=-.59$ ,  $p=.56$ ). At 24 months all 32 tod-

dlers succeeded in selecting the intended referent (Unknown-Known trials:  $t(31)=-3.88$ ,  $p=.001$ ). Preliminary analyses with data from 23 toddlers aged 21 months find monodialectals use Mutual Exclusivity (Unknown-Known trials:  $t(17)=-2.97$ ,  $p=.009$ ) but multidialectals do not (Unknown-Known trials:  $t(4)=-.61$ ,  $p>.05$ ).

These results draw parallels with the monolingual and bilingual findings where increased variation in the input delays the use of Mutual Exclusivity.

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.. 17:35 – 17:55 (206) ..

**The computational challenge presented by non-referential linguistic variability.** T. FLORIAN JAEGER<sup>1</sup>, DAVE KLEINSCHMIDT<sup>2</sup>, LINDA LIU<sup>1</sup> & XIN XIE<sup>1</sup>; <sup>1</sup>University of Rochester, United States of America; <sup>2</sup>Princeton University, United States of America

Talkers vary in how the map linguistic categories (words and phonemes) onto the speech signal. The resulting lack of invariance problem is one of the primary reasons automatic speech recognition remains a hard problem. How the human mind/brain overcomes this problem is one of the central questions in research on speech perception. We will present a computational framework that addresses this problem—how listeners understand speech by learning and remembering talker-specific models, and by generalizing them to similar novel talkers. This ideal adapter framework can also account for social inference listeners implicitly draw based on the properties of a talker's speech. We present evidence that speech perception indeed draws on inference under uncertainty not only about linguistic categories (i.e., what's being said), but also about the generative models appropriate for the current input (i.e., how it's being said).

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.. 17:55 – 18:15 (207) ..

**Dialectal and foreign accented speech processing: Electrophysiological evidence for the Perceptual Distance Hypothesis.** CLARA D MARTIN<sup>1,2</sup>, ALEJANDRO PÉREZ<sup>1</sup> & SENDY CAFFARRA<sup>1</sup>; <sup>1</sup>BCBL, Spain; <sup>2</sup>IKERBASQUE, Spain

Despite the growing research on accented speech, it is still unclear whether there is a continuum in speech processing from native accented speech to foreign accented speech, with dialectal accented speech falling in between (Perceptual Distance Hypothesis) or whether processing foreign and dialectal accents is qualitatively and functionally different (Different Processes Hypothesis). To address this debate, we explored neural oscillatory activity and event-related potentials (ERPs) during

listening to native, dialectal and foreign accented speech.

Twenty-six native Spanish speakers from Spain were exposed to continuous speech in Spanish (one 6-minutes conversation per accent type; grammatically and semantically correct) and isolated words (120 words per accent type) during electroencephalogram recording. Conversations and isolated words were uttered by local Spanish speakers (native accent), Spanish speakers with Cuban (dialectal) accent and Italian speakers (foreign accent). Spectral power analyses of speech perception revealed that dialectal and foreign accented speech differed from native accented speech in high frequency (gamma) bands. ERP analyses revealed that isolated word perception differed in dialectal and foreign accented speech relative to native accented speech, in the 250-350 ms time-window (fronto-central Phonological Mapping Negativity; PMN). Importantly, dialectal and foreign accented speech processing did not differ in each of these analyses.

Oscillatory activity in the gamma band during speech perception has been proposed to reflect speech processing at the phonemic level. Moreover, several previous studies have shown that the PMN observed during word processing reflects processes of normalization between acoustic-phonetic input and phonological representations. Consequently, our results suggest that speech and word processing of native language differs when uttered in native relative to non-native accent, mostly at the phonemic/phonological level. Dialectal and foreign accented speech processing does not seem to diverge significantly, which is in favor of the Perceptual Distance Hypothesis.

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## Bilingual / Control H1, Wednesday, 09:00 – 10:40

.. 09:00 – 09:20 (208) ..

**What absent switch costs during bilingual language comprehension can tell us about language control.** MATHIEU DECLERCK<sup>1</sup>, IRING KOCH<sup>2</sup>, JON ANDONI DUÑABEITIA<sup>3</sup>, JONATHAN GRAINGER<sup>1</sup> & DENISE N. STEPHAN<sup>2</sup>; <sup>1</sup>Aix-Marseille Université and Centre National de la Recherche Scientifique, France; <sup>2</sup>RWTH Aachen University, Germany; <sup>3</sup>Basque Center on Cognition, Brain and Language, Spain

In the current study, we set out to investigate language control, which is the bilingual process that minimizes cross-language interference, during bilingual language comprehension. Accord-

ing to models of bilingual language comprehension, language-switch costs, which is a marker for language control, should be observed. However, a closer look at the literature seems to indicate that this effect is not consistent across and even within studies. This is rather surprising, as absent switch costs in other domains than bilingual language comprehension (e.g., task switching and production-based language switching) are very uncommon. In the current study, we further investigated comprehension-based language-switch costs, and found no evidence for this effect in six experiments, using different tasks (parity, magnitude, and animacy tasks) and different bilinguals (French-English and French-Spanish), and an overall analysis with 120 bilinguals. Though, other types of switch costs were observed in the current study with the exact same setup (i.e., task-switch costs, stimulus modality-switch costs, and production-based language-switch costs). We assume that the absence of language-switch costs with comprehension tasks is due to relatively little parallel language activation that can occur during bilingual language comprehension. Based on this, we modified the original BIA model of bilingual language comprehension by adding a conflict monitoring aspect to it.

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.. 09:20 – 09:40 (209) ..

**Voluntary language switching: When and why do bilinguals switch between languages?** ANGELA DE BRUIN<sup>1</sup>, ARTHUR G. SAMUEL<sup>1,2</sup> & JON ANDONI DUÑABEITIA<sup>1</sup>; <sup>1</sup>Basque Center on Cognition, Brain and Language, Donostia, Spain; <sup>2</sup>Department of Psychology, Stony Brook University, United States

Many bilinguals switch between languages in daily life. Several studies have addressed this topic using cued picture naming paradigms instructing participants when to switch. However, little is known about voluntary language switching: When and why do bilinguals switch when they are free to choose the naming language? Previous work (e.g., Gollan & Ferreira, 2009) has suggested that bilinguals still switch frequently when they are not specifically instructed to do so. The current study examines how several characteristics related to the individual bilinguals as well as the items affect voluntary switching and language choice. One hundred young Spanish-Basque bilingual adults (50 balanced, 50 unbalanced) completed a picture naming task in which they were free to name the pictures in the language that came to mind first. Participants also completed verbal and non-verbal working memory tasks, as well as measures of inhibition and language proficiency. The results suggest that both balanced and unbalanced bilinguals spontaneously switch frequently

between languages. Furthermore, the number of switches, the naming language, and response times were affected by a number of variables including word frequency, language balance, and working memory capacity. Thus, balanced and unbalanced bilinguals voluntarily switch between languages but their choices and performance are affected by characteristics related to both the participants themselves and the items that need to be named.

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.. 09:40 – 10:00 (210) ..

**Assessing bilingual language switching behavior with Ecological Momentary Assessment.** JUSSI VIJAMI JYLKKÄ<sup>1</sup>, ANNA SOVERI<sup>1</sup>, MATTI LAINE<sup>1</sup> & MINNA LEHTONEN<sup>1,2</sup>; <sup>1</sup>*Department of Psychology, Abo Akademi University, Finland*; <sup>2</sup>*Department of Psychology and Logopedics, Faculty of Medicine, University of Helsinki, Finland*

#### Background

It has been suggested that everyday language switching frequency in bilinguals is associated with better executive functions (EF), but the evidence for this claim is inconsistent. The inconsistency could indicate either that such association does not exist, or that the methods of assessing language switching or EF are invalid. Here we use Ecological Momentary Assessment (EMA) to examine the validity of the Bilingual Switching Questionnaire (BSWQ) and the associations between language switching and EF.

#### Methods

The participants were 30 early Finnish-Swedish bilinguals. They underwent a two-week EMA period, under which they answered a set of four language switching questions six times a day on approximately two-hour intervals. The EMA questions assessed the same language switching behaviours as BSWQ, namely Intended Switches, Unintended Switches, and Contextual Switches (CS). Additionally, the subjects performed executive tasks assessing inhibition (Simon and Flanker tasks), set shifting (number-letter task), and working memory updating (visuospatial n-back).

#### Results

The correlations between the pre- and post EMA period BSWQ scores indicated that the Language Switches and Unintended Switches factors of the BSWQ were reliable, unlike the Contextual Switches factor. The correlations between the pre-EMA period BSWQ scores and the EMA scores indicated that only the Unintended Switches factor of the BSWQ was valid. As to the EF tasks, we found that higher rate of unintended language switches, assessed with EMA, predicted worse performance in the N-back task.

#### Conclusions

Having a valid method to assess language switching is crucial when investigating the possible associations between language switching frequency and EF. Our results suggest that there are validity problems with BSWQ, and other approaches, such as EMA should be favoured when studying language switching in bilinguals. The associations between switching frequency and the EF tasks did not support the hypothesis that language switching trains EF.

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.. 10:00 – 10:20 (211) ..

**Findings from GECO, The Ghent Eyetracking Corpus of mono- and bilinguals reading an entire book.** WOUTER DUYCK<sup>1</sup>, NICOLAS DIRIX<sup>1</sup>, USCHI COP<sup>1</sup>, DENIS DRIEGHE<sup>2</sup>, EVA VAN ASSCHE<sup>1</sup> & EMMANUEL KEULEERS<sup>1,3</sup>; <sup>1</sup>*Ghent University, Belgium*; <sup>2</sup>*University of Southampton*; <sup>3</sup>*Tilburg University*

This paper presents GECO (Ghent Eye-tracking Corpus), the monolingual (English) and bilingual (Dutch-English) eye-tracking corpus of participants reading a complete novel (56000 words). In this talk, we will present descriptive statistics of the most important reading time measures for first-language (L1) and second-language (L2) reading. We will also present in-depth analyses of frequency, neighborhood size, cognate effects and (L1 and L2) age of acquisition effects for L1 and L2 sentence reading. Results showed smaller frequency effects in L2 than in L1. Both L1 and L2 frequency effects interacted with L1, but not L2 proficiency. Both L1 and L2 reading showed intra- and cross-lingual effects of neighborhood size and cognate status. Age of Acquisition effects occurred largely, but not exclusively, within-languages. Also, overall bilingual L1 reading did not differ from monolingual L1 reading. Our results are consistent with an account of bilingual language processing that assumes an integrated mental lexicon with exposure as the main determiner for lexical entrenchment. Findings will be framed within theories of monolingual and bilingual reading, and relative to the weaker links account of bilingualism. This freely available large eye-tracking corpus is perfectly suited for further exploratory purposes as well as more directed hypothesis testing, and it can guide the formulation of ideas and theories about naturalistic reading processes in a meaningful context.

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.. 10:20 – 10:40 (212) ..

**Cognate effect in noise: Selective activation of the unattended language in bilingual word recognition.** CLARA D MARTIN<sup>1,2</sup>, SENDY CAFFARRA<sup>1</sup>,

SOPHIE SCHLOEFFEL<sup>1</sup>, ALEXIA ANTZAKA<sup>1</sup>,  
MARIE LALLIER<sup>1</sup> & MANUEL CARREIRAS<sup>1,2</sup>;  
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One major debate in research on bilingualism is whether the two languages of a bilingual speaker are constantly co-activated, even when performing a task in only the attended language. The fact that cognates (words sharing form and meaning across languages) are processed differently than non-cognates (the so-called ‘cognate effect’) has been taken as evidence for constant language co-activation. However, the cognate effect could also be explained by a special status for cognates, inherited from second language (L2) acquisition, with no need to assume persistent language co-activation. Interestingly, both accounts should predict a larger cognate effect in noisy speech, since weak representations are more affected by noise than strong representations (i.e., non-cognate versus cognate differences should be amplified). Alternatively, if we assume the existence of language co-activation that can be suppressed under adverse conditions, the cognate effect should be reduced in noise (i.e., similar processing for cognates and non-cognates when the influence of the unattended language is suppressed).

Here, we manipulated the cognate status of words (cognate, non-cognates) and the level of noise (clear, noisy speech) in two experiments in which participants had to decide whether a written and a spoken word presented simultaneously matched or not, during EEG recording. Eight year-old Spanish-Basque bilingual children performed the task in Basque (L2) and adults performed the task in Spanish (L1).

In both experiments, a significant cognate effect was observed on the N250 ERP component, reflecting sublexical orthography-phonology mapping. Importantly, the cognate effect was significantly reduced in the noisy condition in both experiments. We argue that these results cannot be accounted for by neither a constant or absent language co-activation. They rather reveal that language co-activation does exist in the bilingual brain but that this co-activation of the unattended language is selective and can be suppressed under adverse conditions such as noisy speech.

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## Task Switching, Dual-tasks H2, Wednesday, 09:00 – 10:40

.. 09:00 – 09:20 (213) ..

**Functional differences between guessing versus choosing an upcoming task.** THOMAS KLEINSORGE & JULIANE SCHEIL; *Leibniz Research Centre for Working Environment and Human Factors (IfADo), Germany*

In the present study, we replicated and extended previous evidence regarding functional differences between guessing versus choosing an upcoming task. Participants switched among four tasks and were asked to predict the upcoming task on each trial. Under otherwise strictly identical conditions, these predictions were instructed to participants as either ‘guessing’ or ‘choosing’ the next task. Furthermore, we varied the proportion of trials in which the presented task conformed to participants’ predictions on three levels. Whereas with choosing instructions task (un)expectedness affected task switches and repetitions similarly, with guessing instructions we observed significantly reduced switch costs for unexpected tasks. This interaction was unaffected by the proportion of expected tasks. We propose that with choosing instructions, the impact of a mismatch between chosen and presented tasks is reduced by explicit knowledge regarding the proportion of denied choices. With guessing instructions, in contrast, task unexpectedness mainly increases task difficulty, which is compensated by an increase of cognitive control that reduces switch costs.

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.. 09:20 – 09:40 (214) ..

**Effects of stimulus-response modality mappings on the ordinal prioritization structure among effector systems in dual-task control.** MAREIKE AMELIE HOFFMANN, ALEKS PIECZYKOLAN & LYNN HUESTEGGE; *University of Würzburg, Germany*

Former research has shown that performance costs in dual tasks are often distributed asymmetrically among different effector systems. This can be interpreted as prioritization of one effector system (the one associated with smaller dual-task costs) over the other one. Huestegge and Koch (2013) suggested an ordinal prioritization structure for effector systems, in which saccades are prioritized over both vocal and manual responses while vocal responses are prioritized over manual responses. However, they only analyzed compounds of responses which were both triggered by the same auditory stimulus. Thus, it is still unclear whether a similar ordinal structure can be found in typical

dual-task situations and to what extent this structure is determined by the stimulus modality (input-output modality compatibility effect, see Hazeltine et al., 2006). In the present study, we compared dual-task costs of different effector systems in pairwise combinations of independently triggered oculomotor, vocal, manual, and pedal responses as a function of stimulus-response (S-R) modality mapping. Results suggest that S-R modality mappings affected dual-task performance in some effector system combinations, but did not change the overall ordinal prioritization structure: Saccades were prioritized over pedal, vocal, and manual responses, while pedal responses were prioritized over both vocal and manual responses in typical dual-task situations. For the combination of vocal and manual responses, task characteristics (including stimulus modality or dimensional overlap) had an especially pronounced effect on the dual-task cost pattern. Overall, the present results call for a distinct effector modality weighting mechanism in models of dual-task control.

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.. 09:40 – 10:00 (215) ..

**Introspection About the Effects of Task Switching and Memory Load.** DANIEL BRATZKE & DONNA BRYCE; *University of Tübingen, Germany*

In multitasking situations, two types of reaction time (RT) costs can be typically observed: dual-task costs and switch costs. Dual-task costs arise when people try to perform more than one task at the same time, whereas switch costs arise when people switch between different tasks. Previous research has demonstrated that trial-by-trial estimates of objective RTs (i.e. introspective RTs) are usually distorted in such a way that participants appear to be unaware of their dual-task costs. In contrast, recent results from an introspective task-switching study suggest that people are aware of their switch costs as their objective switch costs were fully reflected in introspective RTs. In the present study we assessed introspective RTs in a task-switching paradigm which combined a digit classification and a memory search task. A previous study using this paradigm showed that concurrent timing (i.e., time production) was affected by memory load but not by task switching demands (Fortin, Schweickert, Gaudreault, & Viau-Quesnel, 2010). Inconsistent with Fortin et al.'s results, in our study introspective RTs reflected both the memory load effect and the switch costs. Taken together, these results suggest that introspective RTs are not identical to estimates of concurrent timing but rather reflect retrospective inference about task performance based (at least partly) on other information than time. This suggestion is in line with the common distinction between prospective and retrospective timing.

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.. 10:00 – 10:20 (216) ..

**Examining the Role of Working Memory Capacity and Age in Task Shifting.** GIDON T. FRISCHKORN, ANNA-LENA SCHUBERT & DIRK HAGEMANN; *Heidelberg University, Germany*

Shifting between different tasks is one of the fundamental cognitive abilities of humans. This task shifting process is often described as one of three main executive functions that regulate attentional processes (Miyake et al., 2000) and may underlie more general cognitive functions such as working memory or general intelligence (Miyake et al., 2001 & Wongupparaj et al., 2015).

The present study explored whether switching between two simple cognitive tasks (i.e. deciding whether a number is smaller or larger than 5 or odd or even) is related to capacity of working memory and age. Results showed that people with higher working memory capacity decided faster in both tasks and older people decided more slowly in both tasks. Moreover participants decided considerably slower when they had to switch from one task to the other. However, this effect was neither moderated by working memory capacity nor age.

These results suggest that the ability to shift different tasks is neither related to working memory capacity nor decreases it when people get older. Switching to a new task thus requires some additional processing steps resulting in deteriorated performance. However, the efficiency in the execution of these additional processing steps does not seem to be related to higher order cognitive processes nor does it decrease with age.

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Miyake, A. et al. (2001). How are visuospatial working memory, executive functioning, and spatial abilities related? A latent variable analysis. *Journal of Experimental Psychology: General*, 130(4), 621–640.

Wongupparaj, P. et al. (2015). The relation between a multicomponent working memory and intelligence: The roles of central executive and short-term storage functions. *Intelligence*, 53, 166–180.

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.. 10:20 – 10:40 (217) ..

**Integrated measures of speed and accuracy: Are they useful?** ANDRE VANDIERENDONCK; *Ghent University, Belgium*

While for a long time the inverse efficiency score



was the only measure available to combine speed and accuracy of responding into a single score, in the last decade several new integrated measures of speed and accuracy have been proposed. A comparative study of these measures based on Monte Carlo simulations showed that only three measures achieve a balanced integration of speed and accuracy scores [Vandierendonck, A. (2017). A comparison of methods to combine speed and accuracy measures of performance: A rejoinder on the binning procedure. *Behavior Research Methods*, 49, 653-673. Doi: 10.3758/s13428-016-0721-5]. As a follow up on the boundary conditions of the conclusions acquired by this comparative study, the three allegedly valid integrative measures (inverse efficiency score, rate correct score, and linearly integrated speed-accuracy score) were tested on a number of available data sets in the context of task switching. In each of these experiments, signal-detection analyses and analyses of the effect sizes of the three integrated measures were performed. The results of these analyses will be presented. Although, overall these findings confirm that the three measures are efficient at detecting combined speed and accuracy effects, the findings also reveal that, in particular the rate correct score, was vulnerable to "false alarms" in the detection of effects, by indicating the presence of an effect where none was present in either speed or accuracy scores. Implications of these findings are discussed.

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## Embodied Cognition I H5, Wednesday, 09:00 – 10:40

.. 09:00 – 09:20 (218) ..

**Usual or unusual actions: How action context modulates the action-language relationship.** SOPHIE-ANNE BEAUPREZ & CHRISTEL BIDET-ILDEI; *University of Poitiers, France*

Numerous studies in the field of embodied cognition have shown a link between language and sensorimotor processes (Glenberg and Kaschak, 2002). Moreover, it has been demonstrated that the sentential context of presentation of a word can modulate this language-action relationship (Taylor and Zwaan, 2008). However, no study has investigated the reciprocal view, namely, assessing whether the context in which an action is performed can modulate the word processing.

To test this assumption, the 22 participants of our study observed a prime consisting of a cartoon picture representing a person performing an action in either a usual or an unusual context (watering a

plant vs watering a computer). Then, they had to perform a semantic decision task involving action verbs that could be congruent or incongruent with the action presented in the prime.

Data analyses showed a facilitation effect on response times for congruent action verbs compared with incongruent action verbs in the usual context, whereas no facilitation effect was observed in the unusual context. This finding indicates that the action-language relationship appears only when actions are presented in a usual context demonstrating that the context of action presentation is crucial to observe a link between action and language. A possible interpretation of this result could rely in a decrease in sensorimotor activation related to the atypical context of presentation of the action: unusual actions could be unable to activate sensorimotor processes or at least that such an activation would be weaker than for usual actions. To test this hypothesis, we recently conducted a second study in which we collected electroencephalographic data. We are currently analyzing it with the aim to determine the neural substrates involved in the on/off switch of the action-language relationship observed in our study.

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.. 09:20 – 09:40 (219) ..

**EEG Evidence on the Interplay between Action Language and Perspective Taking.** CLAUDIA GIANNELLI & SILVIA MENCARAGLIA; *University of Potsdam, Germany*

Experiencing actions as agents allows us to have a peculiar perspective, as well as to plan, control and execute actions with different goals, means and degrees of complexity. Nevertheless, we frequently turn to an observer perspective, helping us to understand, predict and manipulate the actions of others and their outcomes. What happens when these actions are just linguistically described? What remains of our privileged agent perspective? Is a general, agent-independent sensorimotor representation activated? Or are distinct sensorimotor representations activated according to different action perspectives?

The present study is composed by two experiment, both employing stimuli composed of hand-related actions (written in Experiment 1, spoken in Experiment 2) presented in German under four different conditions: in the infinitive form ("greifen", "to grasp"), or conjugated in the first ("Ich greife", "I grasp"), second ("Du greifst", "You grasp"), third ("Er/Sie greift", "He/She grasps") person. Participants were requested to carefully read/listen to the linguistic instances while the EEG signal was continuously recorded.

Analysis of cortical oscillations, particularly focusing on alpha and beta sensorimotor rhythms, al-

lowed us to investigate whether different linguistic perspectives (infinitive vs 1st vs 2nd vs 3rd) produced different patterns of EEG activity.

Data showed that different linguistic perspectives elicited different cortical patterns as shown by both magnitude and latency of rhythm desynchronization, suggesting that peculiar sensorimotor patterns are elicited by the presence of an internal (agent) perspective. Furthermore, we produce new comparative evidence on the interplay between action language and linguistic perspective in the written and the auditory modality.

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.. 09:40 – 10:00 (220) ..

**Chewing a gum interferes with abstract concepts' processing.** LUISA LUGLI<sup>1</sup> & ANNA M. BORCHI<sup>2,3</sup>; <sup>1</sup>University of Bologna, Italy; <sup>2</sup>Sapienza University of Rome, Italy; <sup>3</sup>Italian National Research Council, Rome

One of the crucial challenges for embodied and grounded cognition views is to explain how abstract concepts are represented. According to the Words as Social Tools (WAT) proposal (Borghi & Binkofski, 2014), abstract words would be acquired and represented relying not only sensorimotor but also on linguistic and social experience. Evoking linguistic experience would lead to a higher activation of the mouth with abstract than with concrete concepts, as demonstrated by recent behavioral evidence showing a facilitation in responses with the microphone or with a device involving the mouth. As to concrete concepts, embodied views posit that manipulable objects activate more the hand motor system. In this work we intended to investigate whether moving the hand vs. the mouth had a different effect on processing of concrete and abstract words (database by Della Rosa et al., 2010). Depending on the condition, participants were either asked to squeeze a ball (active hand interference), to chew a gum (active mouth interference), to suck a candy (control condition comparable for hedonic experience). Their task consisted in rating on a 5-points scale pleasantness and difficulty of concrete and abstract words (Topolinsky et al., 2014). The words were shown on a computer screen; half of the participants responded using a mouse, the other half touching the screen. Overall, we found that abstract words were evaluated more pleasant and less difficult than concrete words. Consistently with the predictions of embodied views on hand involvement, difficulty ratings increased in the ball condition compared to the conditions involving the mouth, when responses were given with the mouse. During touch screen responses in the gum condition the advantage of abstract concepts in pleasantness ratings was reduced, and their difficulty ratings increased. This

supports the prediction of the WAT proposal, suggesting that chewing the gum actively interferes with abstract concepts.

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.. 10:00 – 10:20 (221) ..

**Does forward and backward walking impact the processing of temporal and spatial concepts?**

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Background:

Embodied Cognition accounts postulate that sensorimotor processes form our concepts in a substantial way. As a consequence, a concept should become reactivated when an associated sensorimotor aspect of the concept is active. Although empirical evidence for links between actions and representations of concrete concepts has been well established, it is not clear whether this holds true for abstract concepts, which cannot be directly perceived with our sensorimotor system (i.e., temporal concepts such as "future").

Method:

In a within-subject design, participants learned object-space (Exp. 1) or object-time (Exp. 2) associations. Afterwards, participants were asked to assign the objects to their location in space/time meanwhile they walked backward, forward, or stood on a treadmill. Response time and number of correct items served as dependent variables. We hypothesized that walking backward would facilitate the on-line processing of "behind"/"past"-related stimuli, but hinder the processing of "ahead"/"future"-related stimuli, and a reversed effect for forward walking.

Results:

In line with Embodied Cognition accounts, a linear mixed model analysis revealed a faster processing of "ahead"-related (Exp. 1) and "future"-related (Exp. 2) stimuli during backward walking, but no differences during standing. Including order of conditions or age did not impact the model. Contrary to the hypothesis, during forward walking stimuli were processed equally fast.

Discussion:

The present results are consistent with the general notion that spatial as well as temporal concepts interact with sensorimotor processes. In two experiments, backward walking affected the processing of spatial/temporal concepts, whereas forward walking did not affect the processing of spatial/temporal concepts. These results add evidence to previous research showing a similar, selective effect of whole-body backward motion on time-related stimuli (Hartmann & Mast, 2012). Potential moderating factors such as movement familiarity

are discussed.

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.. 10:20 – 10:40 (222) ..

**Rodin was Right: Holding your Chin Improves Cognition.** TATIANA HATUKAI<sup>1,2</sup> & MARTIN H. FISCHER<sup>2</sup>; <sup>1</sup>*Tel-Aviv University, Israel*; <sup>2</sup>*Potsdam University, Germany*

Previous research (1) revealed that hand posture alters attention in the simplest perceptual tasks. For example, in the well-known Stroop task participants identify, while timed, the ink color in which color words are printed. The Stroop effect is a direct measure of selective attention (indeed, its failure) in that performance is better for congruent (the word RED in color red) than for incongruent (RED in blue) stimuli. Here, participants were presented with the classic Stroop stimuli and spoke aloud the name of the color print. We varied the position in which the participants held their hands: In the first condition, participants classified color prints while they held their hands on the sides of the screen monitor (2). In the second condition, they performed the task while they held their chin with one hand. In the third condition, they performed with both hands on their lap. Remarkably, hand postures altered color naming performance: responses were faster in the first two regimes than in the third regime, resulting in smaller Stroop effects. These results fail to replicate the observation of an elimination of the Stroop effect when the hands are near the display (2). However, the pattern of results would not be possible if attention was in fact insensitive to hand posture. We conclude that the hands play an active role in guiding selective attention.

#### References

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## Judgment and Decision Making H6, Wednesday, 09:00 – 10:40

.. 09:00 – 09:20 (223) ..

**Diminishing effects of multiple stereotypical information on probabilistic inferences.** TILLMANN NETT, ANGELA DORROUGH, MARC JEKEL & ANDREAS GLÖCKNER; *FernUniversität in Hagen, Germany*

Cues for probabilistic inferences are weighted differently depending on various potentially irrelevant factors such as fluency, accessibility or additional background information about the cue. In previous work, we have shown that people tend to trust a recommendation for a product more strongly if the gender of the person matches with the gender stereotypically associated with the type of product (e.g. hand-lotion recommended by a woman vs. men) even if the cue validity is hold constant. In a comprehensive study (N=109), we investigate how people integrate gender information in more detail. In a repeated fictional product-selection-task, we varied the number of matching and non-matching cues across trials. We show that a single matching cue strongly influences the decision behavior while the impact of additional matching cues is much lower. This diminishing effect of multiple stereotypic information indicates that cues are not weighted independently of each other with equal additive contributions of each piece of stereotype information. Rather, cues and stereotypes seem to be simultaneously integrated in a holistic manner. We discuss this evidence in relation to theories that postulate parallel processing of cues, such as the parallel constraint satisfaction model for decision making (Glöckner & Betsch, 2008).

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.. 09:20 – 09:40 (224) ..

**Spatial dependency in local resource distributions.** ANDREAS WILKE, TAYLOR DAWLEY & JOSIE LYDICK; *Clarkson University, United States of America*

Background. We investigated the presence and absence of different local resources to determine their underlying spatial distributions. Past psychological research has typically focused on empirical resource distributions of equal base rates—such as a 10x10 grid with resource spots that have 50 resources/tokens in it—to compute alternation probabilities that are indicative of how clumpy, random or dispersed the distribution types are. The current methodology focuses on an ecological point pattern analysis to overcome this limitation.

Method. Over recent semesters, we observed and coded various modern resource domains at our university campus, such as seats taken at a café and

in a restaurant, as well as used spots on a parking lot. To determine the evolutionary relevance of such spatial distributions, we needed to incorporate natural resource domains, such as animal distributions and land use. Thus, we extended our research to include the distribution patterns of local cow and geese populations, as well as patterns of wilderness, wild forest, lakes, rivers and streams in the nearby Adirondack Mountains, which spans more than 6 million acres of protected wilderness in New York State. Through the use of an aerial drone, we were able to obtain video footage of the animal distributions. We extracted still images and placed digital grids over each shot to measure the observed ecological presences and absences of the animal resources. Individual distribution types for land use were compiled from published map data from the Adirondack Park Agency.

**Results.** Our results provide evidence that natural resource domains indeed show similar, yet more aggregated distribution patterns than the man-made modern resource domains.

**Discussion.** We discuss our results in light of claims that our ancestral human cognitive evolution selected for specific reasoning mechanisms to detect resources that are distributed in clumps or patches in space and time.

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.. 09:40 – 10:00 (225) ..

**Salient but irrelevant information can bias judgments by inducing the retrieval of exemplars.** AGNES SCHOLZ & BETTINA VON HELVERSEN; *University of Zurich, Switzerland*

Some judgments require ignoring information. For instance, when inferring the the quality of an applicant for a specific position, the decision maker should only consider the attributes of the applicants that are relevant for the decision (e.g., their language abilities) but ignore irrelevant attributes such as the persons' name. Past research, however, indicates that seemingly irrelevant attributes can influence judgments. One explanation is that irrelevant attributes automatically activate memories about similar past instances (i.e. former applicants), which then are integrated into the judgment process. The aim of the current study was to investigate this hypothesized link between the retrieval of specific exemplars in memory and the influence they exert on judgments. To this goal, we used a new method, based on the recording of eye movements, that allows for assessing which information is retrieved from memory. In accordance with research showing that when people retrieve information from memory they look back to the location where they encoded it, we measured whether participants retrieved previously encountered exemplars during judgments. Our results show that

participants were more likely to retrieve an exemplar when it matched the test item on an irrelevant attribute. In addition, irrelevant attributes influenced judgments in the direction of the retrieved exemplar. However, first analyses suggest only a small link between gaze behavior and judgment bias, suggesting that retrieval does not necessarily affect judgments. These results provide first insights into how memories about exemplars are integrated into the judgment process when assessing memory retrieval online.

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.. 10:00 – 10:20 (226) ..

**Risk preferences in surrogate decision making.** ELEONORE BATTEUX, EAMONN FERGUSON & RICHARD TUNNEY; *University of Nottingham, United Kingdom*

**Background:** A large proportion of our everyday decisions are made on behalf of other people. There is growing evidence that surrogate decisions differ from the ones we make for ourselves because we are less affected by the subjective experience of their outcome. As a result, the decisions we make for other people tend to be more optimal. We present an experiment investigating how our risk preferences are altered in surrogate decision making in order to shed some light on contradictory findings in the literature.

**Method:** Risk preferences were elicited using a probability discounting task where participants made choices between a guaranteed amount and chance of winning a larger amount. Psychological distance between the decision maker and the recipient was manipulated by having participants make decisions for themselves, their friend and another unknown participant. Participant compensation was made contingent on choices made during the task. Decisions therefore had a real outcome affecting real recipients.

**Results:** Risk preferences were closer to neutrality (i.e. more consistent with expected value) when making decisions on behalf of another participant than when making decisions for themselves or for a friend. Participants who were risk-averse for themselves took more risks for someone else, whereas those who were risk-seeking for themselves took less risks for someone else.

**Discussion:** We conclude that subjective risk preferences are attenuated in surrogate decision making. Surrogate decisions become increasingly different from decisions made for the self as psychological distance between the decision maker and the recipient increases. We have demonstrated that self-other differences are not due to a categorical distinction between 'self' and 'other', but rather that the identity of the recipient has a systematic effect on the decision process, and that individual

differences in risk preferences alter the direction of self-other differences.

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.. 10:20 – 10:40 (227) ..

**What could define a good lie detector? A cognitive perspective of deception detection.** GEOFFREY DURAN, GEORGE ANDREW MICHAEL, AN-NICK DUCHÈNE & ISABELLE TAPIERO; *Laboratoire d'Etude des mécanismes cognitifs, France*

**Background:** Lies represent an important part of social interactions and most of the time people fail to detect them. But it is also assumed that people vary in the ability to catch liars and the reasons remain unclear. Few studies showed a right-hemisphere dominance for detection of deception. This finding was interpreted as the implication of emotional functions mediated by the right hemisphere. This result underlines the importance of investigating individuals' ability to detect lies, but most interpretations focus only on the role of emotional functions. The purpose of this study was to examine the relationship between different cognitive functions, some mediated by the right hemisphere and others mediated by the left, and deception detection.

**Method:** Fifty-two men and fifty-two women were required to complete a questionnaire of self-monitoring and completed auditory tasks evaluating mental imagery, perception of emotional prosody, attentional, semantic discrimination, discourse comprehension and lexical decision. Afterwards, an auditory truth-lie detection task was completed where participants were required to judge the veracity of 20 recordings of people presenting a person.

**Results:** Signal detection analyses were carried out to unravel the ability to distinguish false from truthful videos ( $d'$  index) and response trends (C criterion). Multiple regression analyses showed that only mental imagery predicted the ability to distinguish truth from lies and only perception of emotional prosody predicted response trends, here the truth bias.

**Discussion:** These results suggest that mental imagery and the perception of emotional prosody influence the ability to detect deception. It seems that the ability to make a representation of what people say helps detectors identifying lies. Contrary to previous research, we suggest that emotional functions influence responses towards a truth bias.

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## Memory Retrieval and Conditioning

H8, Wednesday, 09:00 – 10:40

.. 09:00 – 09:20 (228) ..

**Characterizing the developmental trajectory of cognitive control, memory encoding and memory retrieval: Longitudinal behavioral and ERP evidence.** DANIELA CZERNOCHOWSKI; *TU Kaiserslautern, Germany*

The development of episodic memory in children is far from understood. Children acquire vast amounts of new information, although many cortical areas recruited during memory formation and retrieval in young adults have not reached functional maturity. Little is known about the cognitive processes supporting memory in developmental populations, for instance when children start to consider semantic information along with perceptual item features. Based solely on behavioral outcome during memory retrieval (for instance types of memory errors), it is difficult to dissociate memory development per se from generalized cognitive control abilities contributing to reliable memory judgments. Moreover, comparable behavioral performance might be based on distinct cognitive processes, as indexed by ERPs. In addition, cognitive control abilities play a large role for guiding efficient memory search, and selecting between competing response alternatives. Specifically, children's performance difficulties during complex memory tasks might reflect failure to monitor response conflict rather than memory development per se.

The interplay between memory and cognitive control was assessed in a combined cross-sectional and longitudinal design: Children aged 7 and 10 years participated in episodic memory and cognitive control paradigms which were compared to a group of young adults and then repeated after two years. Few age differences were observed with respect to general memory performance, whereas age was associated with a decrease in both reaction times and error rates for the cognitive control task, specifically for the most demanding conditions. Individual ERP waveforms were relatively stable across time, although the age groups differed in the cognitive processes supporting task performance. Thus, understanding the biological processes underlying improved performance can be useful to shed light on the precise mechanisms responsible for developmental progression, such as the maturation of critical brain structures or the gradual use of adult-like retrieval strategies.

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.. 09:20 – 09:40 (229) ..

**Dual-Memory Retrieval Efficiency after Practice: Impact of Strategy Manipulations.** FRANZISKA ORSCHESCHEK<sup>1</sup>, TIMOTHY RICKARD<sup>2</sup>, TORSTEN SCHUBERT<sup>3</sup> & TILO STROBACH<sup>1</sup>; <sup>1</sup>MSH Medical School Hamburg, Germany; <sup>2</sup>University of California, San Diego; <sup>3</sup>University of Halle-Wittenberg

The study investigated the role of practice effects, instruction manipulations and the associated cognitive architecture of dual-memory retrieval from a single cue. Even though there has been an established body of research concerning practice in choice reaction-time tasks and associated dual-task costs, the knowledge about such effects in long-term memory tasks with dual retrieval has still been limited. Additionally, there has been no focus on the effects of instruction manipulations, in the form of response strategy instructions, on the efficiency of dual memory retrieval. To aid the development of adjunct cognitive models we tested predictions about the presence of learned parallelism of dual-memory retrieval within the framework of the set-cue bottleneck model. The present study realized three experimental laboratory sessions including computerized assessments of dual-memory retrieval performance. The strategy instruction manipulations involved three different groups: An instruction to synchronize (i.e., to group) two responses, an instruction to use a sequential response style, and a neutral instruction without a specific instruction on response style. Our results indicate that strategy instructions are able to influence the efficiency of retrieval. Particularly, the instruction to synchronize responses led to enhanced retrieval efficiency and indicated the presence of learned retrieval parallelism. Further results will be discussed with respect to the set-cue bottleneck model.

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.. 09:40 – 10:00 (230) ..

**Distributed practice can boost evaluative conditioning by increasing memory for the stimulus pairs.** JASMIN RICHTER & ANNE GAST; *University of Cologne, Germany*

When presenting a neutral stimulus (CS) in close temporal and spatial proximity to a positive or negative stimulus (US) the former is often observed to adopt the valence of the latter, a phenomenon named evaluative conditioning (EC). It is already well established that under most conditions, contingency awareness is important for an EC effect to occur. In addition to that, some findings suggest that awareness of the stimulus pairs is not only relevant during the learning phase, but that it is also relevant whether memory for the pairings is still available during the measurement phase. As previous research has shown that memory is better

after temporally distributed than after contiguous (massed) repetitions, it seems plausible that also EC effects are moderated by distributed practice manipulations. This was tested in the current studies. In two experiments with successful distributed practice manipulations on memory, we show that also the magnitude of the EC effect was larger for pairs learned under spaced compared to massed conditions. Both effects, on memory and on EC, are found after a within-participant and after a between-participant manipulation. However, we did not find significant differences in the EC effect for different conditions of spaced practice. These findings are in line with the assumption that EC is based on similar processes as memory for the pairings.

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.. 10:00 – 10:20 (231) ..

**I smell, therefore I recall accurately: the connection between fishy smells and resistance to misleading post-event information.** RONA SHEAFFER, ROTEM GAL & AINAT PANSKY; *University of Haifa*

Recent studies on the metaphorical nature of physical experiences indicate that incidental exposure to fishy smells induces social suspicion through the activation of the metaphorical expression "something smells fishy" (Lee & Schwarz, 2012). In two experiments, we tested the universality of the fishy smell metaphorical construct and applied it to the investigation of the misinformation effect. Previous studies have demonstrated that the contaminating effects of misinformation can be reduced by drawing the eyewitnesses' attention to the discrepancy between the misinformation and the original event information (e.g., by instructing participants to read slowly, Tousignant, Hall, & Loftus, 1986; or explicitly warning them about the misinformation, Greene, Flynn & Loftus, 1982). In this study, we tested whether the contaminating effects of misinformation could also be reduced without the awareness of the participants, by using olfactory perceptual cues to invoke suspicion and increase discrepancy detection.

Our first experiment tested the extent to which previous findings of reduced trust-based contributions to a common pool in the presence of a fishy smell (presumably due to increased suspicion; Lee & Schwarz, 2012) would replicate and generalize for Hebrew speaking participants. The (obtained) replication was important and called for, given that the smell that indicates something suspicious is unspecified in Hebrew (in contrast to English).

In the second experiment, the metaphor's long-term effects on subsequent memory was examined using Loftus, Miller, and Burns's (1978) three-stage misinformation paradigm. Participants witnessed a target event, and were then misled about event

details in a room sprayed with either a fish smell or a control (pleasant) smell. As expected, the fishy smell was found to eliminate misinformation interference and lower suggestibility on the final test conducted after 48 hours, compared to the pleasant-smell control condition. The role of unconsciously induced discrepancy detection in reducing the contaminating effects of misinformation is discussed.  
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.. 10:20 – 10:40 (232) ..

**The relevance of memory in smell-taste evaluative conditioning.** BORYS RUSZPEL & ANNE GAST; *University of Cologne, Germany*

Evaluative conditioning (EC) as a way of attitudes formation by repeatedly pairing a previously neutral stimulus (CS) with a valent stimulus (US) is a major topic in attitude research. The relevance of memory for EC effects is a subject of intense research because it is relevant for understanding the processes underlying EC and attitude formation. The main question is whether the attitude change can occur without participants' explicit memory for the co-occurrences between neutral and valent stimuli. The majority of studies show that memory of pairings is a condition for EC effects to occur or leads to stronger effects. In almost all of these studies, however, the used stimuli were visual or auditory. For other modalities there is less evidence for the relation of memory and EC. For the combination of olfactory and gustatory stimuli it has in fact been shown that EC effects occur without knowledge of the co-occurrences (Baeyens et al., 1990; Dickinson & Brown, 2007). To investigate the theoretically important question whether with this modality combination EC effects will occur without memory of pairings, we conducted a conceptual replication of these studies. We used gustatory stimuli as USs, bottle designs as visual CSs and neutral smells as olfactory CSs. We found an overall EC effect that was not moderated by whether the stimulus was visual or olfactory. For both types of modalities, we found EC effects only for remembered and not for non-remembered pairings. These results contradict previous findings and yield important implications for attitude formation research.

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## Emotion

### H1, Wednesday, 12:50 – 14:30

.. 12:50 – 13:10 (233) ..

**The relations between perceptual and processing fluency and intuitive coherence judgments.** JOANNA SWEKLEJ<sup>1</sup> & ROBERT BALAS<sup>2</sup>; <sup>1</sup>*Warsaw School of Social Sciences and Humanities, Poland*; <sup>2</sup>*Polish Academy of Sciences, Warsaw, Poland*

Intuitive judgments are widely considered as one of the main aspects of attitudes and evaluations. They are defined as judgments that are automatic, effortless, and based on instant affective responses. One of the sources of affective responses that influence our judgments is the ease of processing of external stimulation. As previous research shown, more easily processed stimuli are associated with more positive affective responses than stimuli that are processed with more effort. In two studies we test the extent to which those responses are generated by perceptual and processing fluency using semantic coherence judgments paradigm. In this paradigm participants are required to judge whether triplets of words have a common associate word (a solution) or not. We manipulated perceptual fluency with showing participants triplets in high vs. low perceptual contrast. Processing fluency was manipulated by varying the affective value of triplets' solutions. The results revealed that both perceptual and processing fluency contribute to affective responses related to semantic coherence judgments. To the extent that those responses moderated the accuracy of those coherence judgments and participants' confidence in them, it can be concluded that intuitive responding depends on the fluency related to both perception and processing.

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.. 13:10 – 13:30 (234) ..

**Inside out: Implicit and Explicit Associations between Goals and Emotions.** CARLOS ROMERO-RIVAS<sup>1</sup>, SARA RODRIGUEZ-CUADRADO<sup>1</sup> & BELÉN LÓPEZ-PÉREZ<sup>2</sup>; <sup>1</sup>*Edge Hill University, United Kingdom*; <sup>2</sup>*Liverpool Hope University, United Kingdom*

Emotional preferences can be determined by the goals people pursue (Tamir, 2016). Thus, people who are motivated to confront another want to increase their anger (Ford & Tamir, 2012), and people who are motivated to collaborate with another want to increase their happiness (Tamir & Ford, 2012). Nevertheless, it is not clear whether people have implicit associations between goals and emotions, and whether these implicit associations can modulate explicit emotional preferences for goal pursuit. In the present study, 93 participants (M age = 21.06) partook in a masked priming task,

in which goals (i.e., confrontation, collaboration, avoidance, and detailed processing) were presented for 16 ms, followed by a mask that remained on the screen during 200 ms, and an emotional target word (i.e., anger, happiness, fear, and sadness). Participants had to respond whether target words were written in red or blue. They also reported their explicit emotional preferences (i.e., how they wanted to feel) and expected usefulness of different emotions (i.e., how useful they perceived each emotion) for goal pursuit. Results showed that, at an implicit level, participants responded faster on matching trials (e.g., 'anger' primed by 'confrontation') than on mismatching trials (e.g., 'anger' primed by 'avoidance'). Furthermore, at an explicit level, participants preferred to feel and perceived more useful the emotions that matched the goals (e.g., preferring and perceiving more useful 'anger' than any of the other emotions for confrontation scenarios). Importantly, linear regression analyses showed that explicit emotional preferences were fully mediated by the expected usefulness of emotions for goal pursuit. Nevertheless, implicit associations between goals and emotions did not predict the explicit emotional preferences for goal pursuit. These results suggest that what people want to feel is not mediated by implicit associations between goals and emotions, but rather by the expected usefulness of emotions for goal pursuit.

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.. 13:30 – 13:50 (235) ..

**Interactive influences of emotion and extraversion on visual attention during a change detection flicker task.** ROBERT C. A. BENDALL, SHAUNINE BEGLEY & CATHERINE THOMPSON; *University of Salford, United Kingdom*

Emotion has been shown to influence a range of cognitive processes, including selective visual attention. However, past findings in this area have revealed contradictory findings that may be attributed to individual differences. Theories attempt to explain behaviour in terms of group level performance, yet these models often fit less accurately when they are applied to individuals. Adopting a design that combined personality measures and a mood induction procedure, this study aimed to investigate how extraversion influences the effect of emotion on visual attention. Participants viewed a series of positive, negative, and neutral images before completing a change detection flicker task in which they were required to locate a change in a real-world scene as quickly and accurately as possible. Personality traits and levels of emotional affect were measured using self-report questionnaires. Emotion had no main effect on performance in the change detection task, however there was an interaction between emotion and extraversion.

Accuracy to identify changes during the negative emotion condition were greater for those high in extraversion compared to those low in extraversion, whereas no differences in accuracy were evident during neutral mood conditions between high and low extroverts. Additionally, response times during the neutral emotion condition were quicker for the low extraversion group compared to the high extraversion group, whereas during the negative emotion condition no differences in response time were evident between the high and low extraversion groups. Extraversion also significantly improved accuracy and reduced reaction time overall. These findings suggest that individual difference traits can mitigate the influence of emotion on visual attention, and may help to explain some of the contrasting findings in this field.

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.. 13:50 – 14:10 (236) ..

**The effects of emotion and demand on the Attentional Blink.** CATHERINE THOMPSON & DANILA RANIERI; *University of Salford, United Kingdom*

When two targets are presented in close temporal proximity identification of the second target is impaired. This is known as the Attentional Blink (AB). The AB has been found to decrease when individuals are induced into a positive mood and also when they engage in an additional task. This has led researchers to propose that the effect occurs due to an overinvestment of resources in the task (devoting fewer resources improves performance). Two experiments were completed to measure the effects of emotion and demand on the AB. Participants completed three blocks and in each trial were asked to identify two digits from a rapid serial visual presentation of letters. In two blocks a face (positive, neutral, or negative) was presented at the beginning and end of each trial. In one of these blocks participants made no response to the additional stimuli, and in the second they were asked to identify whether the emotion of the face at the end of each trial matched that shown at the beginning. Consistent with past research the addition of a second task reduced the AB, however this did not vary according to whether a response to the faces was required. In contrast to previous work the AB was larger in trials preceded by both positive and negative faces (compared to neutral). These effects support the argument that the AB is due to cognitive control, and instead of influencing the resources given to the task, emotion and demand influence cognitive flexibility.

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.. 14:10 – 14:30 (237) ..

**Dissociating embodied aesthetics and emotional reactivity in motor responses to artworks.** COSIMO URGESI<sup>1,2</sup>, ALESSANDRA FINISGUERRA<sup>1</sup>, LOUISE KIRSCH<sup>3</sup>, SONJA KOTZ<sup>4</sup>, CROSS EMILY S<sup>5</sup> & TICINI LUCA F<sup>6</sup>; <sup>1</sup>University of Udine, Italy; <sup>2</sup>Scientific Institute (IRCCS) E. Medea, Italy; <sup>3</sup>University College London, UK; <sup>4</sup>Maastricht University, The Netherlands; <sup>5</sup>Bangor University, Wales; <sup>6</sup>Manchester University, UK

Previous studies have shown that the perception of artworks elicits activation of the motor cortex in the observers' brain. This activation was initially interpreted as reflecting a covert approach response associated with the emotional value of a piece of art. However, recent hypotheses have proposed that aesthetic experiences are grounded in an embodied simulation of the actions, emotions, and corporeal sensations represented in the artwork or experienced by the artist in producing art ("embodied aesthetics"). To shed new light on this issue, we capitalized on recent single pulse transcranial magnetic stimulation (spTMS) evidence showing a two-stage motor coding of emotional body postures: an early, non-specific activation related to emotion processing and a later action-specific activation reflecting motor simulation. In our work, we asked art-naïve individuals to rate how much they liked a series of canvases painted with a Pointillist or a Brushstroke-like style; photos of artistic gardens served as control natural stimuli. After an early (150 ms) or a later (300 ms) delay from stimulus onset, spTMS motor evoked potentials (MEPs) were recorded from a wrist extensor muscle, which we found to be more involved in painting with a Brushstroke-like than Pointillist style, and a control finger muscle. Results showed that observing canvases elicited overall greater motor activation for both muscles than observing garden pictures. Importantly, a further increase of motor response to Brushstroke-like canvases was specifically obtained at the later delay for the wrist-extensor, but not finger muscle. This is consistent with previous literature regarding earlier, non-specific emotional coding of stimuli and later encoding that relates specifically to action processing. Furthermore, this selective activation correlated with participants' subjective aesthetic ratings of Brushstroke-like canvases and with individual Perspective Taking abilities, supporting the embodied-aesthetics claim that simulation of the painter's movements plays a crucial role in aesthetic experience.

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## Task-specific Attention and Switching Costs

H2, Wednesday, 12:50 – 14:30

.. 12:50 – 13:10 (238) ..

**Identifying the locus of no-go based backward crosstalk: Evidence from an extended PRP paradigm.** MORITZ JOHANNES DURST, SANDRA RENAS & MARKUS JANCZYK; *University of Tübingen, Germany*

A frequent observation in dual-task studies is the backward crosstalk effect (BCE), meaning that aspects of a secondary task influence Task 1 performance. Up to this point, two major types of the BCE were investigated: a BCE based on dimensional overlap between both stimuli and/or responses (the compatibility-based BCE), and a BCE based on whether Task 2 is a go or no-go task (the no-go BCE). Recently, Janczyk, Renas, and Durst (2017, JEP:HPP) localized the compatibility-based BCE inside the response selection stage, which contradicts the widely accepted notion that a capacity-unlimited stage of response activation preceding response selection proper is the locus of the compatibility-based BCE. However, because the available evidence for the locus of the no-go BCE is still mixed, the present study aimed to localize the no-go BCE inside the bottleneck model, applying the logic of the Janczyk et al. study. To this end, two experiments employed an extended psychological refractory period (PRP) paradigm with three subsequent tasks. Applying the locus of slack logic in Experiment 1, the no-go BCE was not absorbed into the cognitive slack, and thus a locus before response selection could be ruled out. Subsequently applying the effect propagation logic in Experiment 2 the no-go BCE arising in Task 1 was even inverted in Task 3. Because no propagation of the no-go BCE was observed, a locus before or in response selection could be ruled out. Thus, we tentatively conclude that the no-go BCE results during motor execution.

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.. 13:10 – 13:30 (239) ..

**The impact of cue format and cue transparency on switch costs and the occurrence of task errors.** MIRIAM GADE & MARCO STEINHAUSER; *Catholic University of Eichstätt-Ingolstadt, Germany*

Humans are remarkably good at making up task-sets, that are cognitive representations of to-be performed task, based on verbal instructions. Cues help in retrieving and implementing task-sets in working memory. However, studies show differential ease of selecting and implementing the correct task-set based on cues. To further add to

the understanding of cue-based selection and implementation processes we ran two experiments in which we manipulated cue format, namely verbal vs. pictorial cues, next to cue transparency (opaque vs. transparent cues) within or between participants. Dependent measures were switch costs found in participants when asked to update working memory content to perform the now relevant task and the occurrence of task errors. Our results show independent effects of cue format and cue transparency on switch costs as well as an interactive effect of both variables on the susceptibility for task errors. Overall, the results highlight the impact of cue transparency.

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.. 13:30 – 13:50 (240) ..

**Self-organized task switching.** ANDREA KIESEL<sup>1</sup>, VICTOR MITTELSTÄDT<sup>1</sup> & JEFF MILLER<sup>2</sup>; <sup>1</sup>*Albert-Ludwigs-Universität Freiburg, Germany*; <sup>2</sup>*University of Otago, New Zealand*

Humans respond more slowly when switching than repeating tasks. Further, humans tend to choose task switches less often than task repetition in the voluntary task switching paradigm (Arrington & Logan, 2004). Yet, little is known about whether we adapt to our individual task-switching performance limitations (i.e., switch costs) when deciding for task repetitions or task switches. In the voluntary task switching paradigm, participants' task choice is restricted due to the global instructions to randomly select tasks. Here, we present a new paradigm to investigate self-organized task-switching. The key manipulation of our paradigm is that the chosen task appears delayed in the next trial and that this delay increases with the number of task repetitions in a run. Consequently, if participants choose to repeat a task, they have to wait longer for the stimulus and this waiting time increases the more often they repeat. We report four experiments in which we assessed whether participants trade off their switch costs against the increasing waiting time for the stimulus needed for a task repetition. Results showed that the tendency to repeat tasks was positively correlated with switch costs across participants. This suggests that participants took into account their individual switch costs when selecting tasks. Overall, the present studies demonstrate that our new paradigm is well-suited to investigate cognitive mechanisms involved in self-organized task-switching.

Arrington, C. M., & Logan, G. D. (2004). The cost of a voluntary task switch. *Psychological Science*, 15(9), 610-615.

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.. 13:50 – 14:10 (241) ..

**Explaining response-repetition effects in task switching: Disentangling contributions from episodic binding and response inhibition.** IRING KOCH<sup>1</sup>, CHRISTIAN FRINGS<sup>2</sup> & STEFANIE SCHUCH<sup>1</sup>; <sup>1</sup>*Institute of Psychology, RWTH Aachen University, Germany*; <sup>2</sup>*Department of Psychology, University of Trier, Germany*

Task switching studies revealed that the usual response-repetition benefit is abolished and often reversed if the task switches. According to episodic binding accounts, performing responses strengthens task-specific bindings, leading to response-repetition benefits in task repetitions, whereas such bindings can lead to interference (i.e., costs of "unbinding") in task switches. An alternative account assumes that responses are generally inhibited after execution. However, in task repetitions, positive priming of stimulus category is stronger than the assumed sequential carryover of response inhibition, resulting in a positive net effect. In the present series of experiments, we introduced variations that should affect episodic binding and response inhibition differentially. Variations of encoding and retrieval context should vary the strength of episodic bindings. Specifically, we varied the modality of the task-cue (visual vs. auditory) across trials and found that the response-repetition benefit in task repetitions was substantially larger with repeated cue modality than with changed cue modality, suggesting that cue modality primes retrieval of task-specific stimulus categories and responses. However, the observed response-repetition cost in task switches remained unaffected by this contextual change, suggesting retrieval-independent response inhibition. Taken together, this data pattern suggests a hybrid account, assuming that response-repetition benefits are driven by episodic bindings, whereas response-repetition costs are primarily due to (non-episodic) carryover of response inhibition.

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.. 14:10 – 14:30 (242) ..

**Preparatory adoption and persistence of task-specific sets of attention.** MIKE WENDT<sup>1</sup>, SVANTJE KÄHLER<sup>2</sup>, AQUILES LUNA-RODRIGUEZ<sup>2</sup> & THOMAS JACOBSEN<sup>2</sup>; <sup>1</sup>*Medical School Hamburg, Germany*; <sup>2</sup>*Helmut Schmidt University/University of the Federal Armed Forces Hamburg, Germany*

Behavioral and physiological evidence suggests the preparation of attentional weighting of stimulus information from different sources, according to task demands. We investigated the preparatory adoption of task-specific attentional sets by asking participants to switch between a flanker task, which required responding to the central letter of a three-letter string, and a same-different

judgment task, which required a homogenous/heterogeneous classification concerning the complete three-letter string. To assess the distribution of attentional weights across the letter locations we intermixed trials of a visual search task, in which a target stimulus occurred randomly in any of these locations. Reaction times in the search task displayed a stronger center-to periphery gradient, indicating focusing of visual attention on the central location, when a cue indicated the likely occurrence of the flanker task as compared to the same-different task. By contrast, search task performance was not affected by the type of the preceding task. In a second experiment, the search task occurred without cue (but the flanker task and the same-different task were always cued in advance, as in Experiment 1). The search time gradient was more pronounced following the flanker task than following the same-different task if the search task stimulus occurred early (i.e., at the time at which the presentation of the task cue was expected) but not when the search task stimulus occurred 800 ms later. Because in the latter condition the absence of an explicit task cue may have served as an implicit cue indicating the search task, this result is consistent with the notion of initial persistence of the attentional set which is, however, overwritten by preparation for a new task. In a third experiment, we demonstrated preparatory focusing, i.e., attentional weighting, on the global or local level of hierarchical (Navon) stimuli using a similar method of intermixing search task trials.

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## Embodied Cognition II

### H5, Wednesday, 12:50 – 14:30

.. 12:50 – 13:10 (243) ..

**Interpersonal Feature Migration: Evidence for Common Mechanisms Underlying Social and Nonsocial Event Representation.** BERNHARD HOMMEL, KE MA, ROBERTA SELLARO & DOMINIQUE LIPPELT; *Leiden University, Netherlands*

According to the Theory of Event Coding (Hommel et al., 2001, BBS), social and nonsocial events are cognitively represented the same way, suggesting that empirical phenomena associated with nonsocial events should generalize to social events. Research on illusory conjunctions demonstrated that features related to one object can be perceived as part of another under suitable circumstances. Here we generalize this observation to social events. Participants faced a virtual head on a monitor in front

of them, which moved synchronously or asynchronously with their own head movements—assuming that synchrony facilitates feature migration from virtual agent to participant. Indeed, facing a smiling head lifted participants' mood and improved their performance in a mood-sensitive creativity task with synchrony but not with asynchrony. In a second study, we slowly morphed the virtual face into an ape face, which in the synchrony condition reduced performance in a fluid-intelligence task and increased the willingness to attribute emotions to apes.

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.. 13:10 – 13:30 (244) ..

**Effect of the positive-negative consequences of motor action and the social context on the representation of peripersonal space.** YANN COELLO, FRANÇOIS QUESQUE, MARIA-FRANCESCA GIGLIOTTI & EKATERINA SHEMAKOVA; *CNRS UMR 9193 SCALab, University of Lille, France*

Space perception is intrinsically linked to the potentiality of objects to suggest motor actions, combined to the anticipation of the effects of actually acting on these objects. According to this approach, peripersonal space defines the region in the environment where actual interactions with objects, considering the current location of the body, can be anticipated. While the relationship between the representation of the body and the representation of peripersonal space has been widely investigated, the role of the objects value has been largely eluded, in particular in the context of social interaction. In the present study, we tested the effect of the positive-negative feedback provided by a stimulus used as a target for action, on the representation of peripersonal space. The task consisted in selecting with the finger 10 out of 32 targets presented at random on a 40" multi-touch table. The selected target could turn red (0 point) or green (1 point), and the likelihood to select a green target to maximise the total of points was either 25%, 50% or 75% in the near and far spaces. Furthermore, the task could be performed either in an isolated (400 trials) or social context entailing a cooperative task in which each participant selected (200) targets. The results show that the representation of peripersonal space, tested through a reachability judgment task performed before and after the target selection task, was modified depending on the distribution of the targets associated with a positive feedback, and extended in the presence of a partner suggesting that objects value but also the outcome of observed actions determine the representation of peripersonal space.

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.. 13:30 – 13:50 (245) ..

**Wearing hyper-realistic masks: a strong manipulation for embodied cognition research.**

JET GABRIELLE SANDERS<sup>1</sup>, AILISH BYRNE<sup>1</sup>, ATSUKO TOMINAGA<sup>2</sup>, KAZUSA MINEMOTO<sup>2</sup>, YOSHIYUKI UEDA<sup>2</sup>, SAKIKO YOSHIKAWA<sup>2</sup> & ROB JENKINS<sup>1</sup>; <sup>1</sup>University of York, United Kingdom; <sup>2</sup>Kokoro Research Centre, Kyoto University, Japan

Recently the replicability of embodied cognition findings has been called into question (Goldinger et al., 2016). For example, there have been high profile failures to replicate pioneering research on facial feedback (Strack et al., 1988), more recent work on power posing (Carney et al, 2010), and even studies relating clothing to math performance (Adam & Galinsky, 2012). One criticism of the field as a whole is that the experimental manipulations do not appear to be very strong. Here, we attempted a strong manipulation: complete transformation of participants' appearance using hyper-realistic silicone face masks. These realistic masks are used in the Hollywood special effects industry to create different lifelike characters. In the current experiments, we assessed participants' strength using self-report and behavioural measures (persistence on a hand-grip task). We manipulated participants' appearance using Young Male Masks (low in age, high in dominance) vs. Old Male/Female Masks (high in age, low in dominance). In each of three experiments, participants who wore a Young Male Mask reported feeling stronger, and compressed a hand-grip for longer, compared with participants who wore the Old Male/Female Mask. This result held across different experimental designs (between-subjects and within-subjects), different masks (of Caucasian and Asian appearance), and different cultural settings (British and Japanese participant groups). We suggest that hyper-realistic face masks can be useful in embodied cognition research because they allow strong manipulations of the independent variable.

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.. 13:50 – 14:10 (246) ..

**Pupillary responses to words that convey a sense of brightness or darkness.**

KRISTOF STRIJKERS<sup>1</sup>, JONATHAN GRAINGER<sup>2</sup> & SEBASTIAAN MATHOT<sup>3</sup>; <sup>1</sup>CNRS & Aix-Marseille University, LPL, France.; <sup>2</sup>CNRS & Aix-Marseille University, LPC, France.; <sup>3</sup>University of Groningen, Department of Experimental Psychology, Netherlands

An embodied view of language holds that when you process a word's meaning, you automatically simulate associated sensory input (e.g. simulate perception of brightness to understand 'lamp') and prepare associated actions (e.g. prepare finger movements to understand 'typing'). While many behavioral studies in the field demonstrate com-

patibility effects between language and their corresponding perceptions or actions, and neuroimage data reveals sensorimotor brain activations in response to language understanding, a central prediction of the embodied language hypothesis has not yet been directly tested: Are such sensorimotor simulations to language automatic, beyond our voluntary or strategic control and beyond experimental specifications (e.g., task requirements) that could impose embodied simulations? To test this latter prediction, we measured pupillary responses to single words, either presented visually (experiment 1, N = 30) or auditory (experiment 2, N = 30), that conveyed a sense of brightness (e.g. 'day') or darkness (e.g. 'night'), or were luminance-neutral (e.g. 'house'). Crucially, we found that the pupil was largest for darkness-conveying words, intermediate for neutral words, and smallest for brightness-conveying words. Put differently, the associated luminance of a word's meaning elicits a pupillary light response similar as to when perceiving actual bright or dark visual stimulation. This pattern was found for both visually presented and spoken words, suggesting that it was due to word meaning, rather than to visual or auditory properties of the stimuli. Our findings suggest that word meaning is sufficient to automatically trigger pupillary movement, even when this movement is not imposed by the experimental task, and even when this movement is beyond voluntary and strategic control.

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## Acquisition and Development

H6, Wednesday, 12:50 – 14:30

.. 12:50 – 13:10 (247) ..

**What do spellings of English suffixes tell us?**

ANASTASIA ULICHEVA<sup>1</sup>, MARK ARONOFF<sup>2</sup> & KATHLEEN RASTLE<sup>1</sup>; <sup>1</sup>Royal Holloway University of London, United Kingdom; <sup>2</sup>Stony Brook University, United States

Background. Substantial evidence indicates that inconsistency harms learning. In the context of learning to read, English-speaking children lag behind their peers learning languages with more consistent spelling-sound correspondences. In the context of language acquisition, the learning of morphology is hindered by the presence of form-meaning inconsistency. If inconsistency is harmful, then why does it emerge?

Method. To answer this question, we examine English spelling – a dynamic system that has

self-organised over centuries. Inconsistent spelling-sound correspondences exist in abundance in English, and while these could have become extinct, this evolution has spared them. We present results of computational linguistic analyses showing that suffix spellings, albeit unpredictable from sound, carry unique information that is not available in phonology.

**Results and Discussion.** We show that English speakers pick up these cues in the absence of formal instruction, and use them explicitly and implicitly when dealing with written language. In particular, they draw inferences about meanings of novel words based on their spelling alone, exploit these cues in their writing of novel words, and rapidly access these in the context of natural sentence reading. We will also discuss individual differences in people's sensitivity to orthographic cues present in English suffixes.

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.. 13:10 – 13:30 (248) ..

**Evaluation of reading and spelling processes in Arabic literacy acquisition.** CAROLE EL AKIKI, ALAIN CONTENT & PHILIPPE MOUSTY; *Université Libre de Bruxelles, Belgium*

Although Arabic is the fourth most spoken language in the world, only few studies target literacy acquisition in Arabic and even fewer focus on spelling. Arabic orthography involves interesting linguistic and orthographic features which can influence the acquisition of literacy and spelling skills. For instance, priming studies suggests the important role of morphology in the organization of the adult mental lexicon in both spoken and written Arabic (Boudelaa, 2014)

The present study attempts to characterize the processes involved in reading and spelling in Arabic. Particularly, we explored the impact of the word roots and patterns on reading and spelling among native Lebanese children from Grades 1 to 4.

We designed a battery of tests evaluating letters, words and pseudowords reading and spelling, reading word comprehension, phonemic awareness, phonological and morphological derivation skills, rapid automatized naming, auditory discrimination abilities and auditory memory span. Hundred and forty Lebanese bilingual children (Arabic/French) in Grade 3 and 4 were tested this year, among whom 120 were also tested last year. The results show that besides phonology, morphology plays an important role in word reading, already at an early level of literacy. The frequency and familiarity of both roots and patterns influence reading, the effect being more significant for patterns especially in pseudowords reading. In addition, we noted a significant difference between de-

rivational and inflectional morphology skills.

**Bibliography:**

Boudelaa, S. (2014). Is the Arabic Mental Lexicon Morpheme-Based or Stem-Based? Implications for Spoken and Written Word Recognition. In Saiegh-Haddad and Maletsha Joshi (Eds.), *Handbook of Arabic literacy: Insights and Perspectives* (31-54)  
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.. 13:30 – 13:50 (249) ..

**The time course of print processing impairments in developmental dyslexia: An ERP comparison between lexical decision and reading aloud.** GWENDOLINE MAHÉ<sup>1</sup>, PASCAL ZESIGER<sup>2</sup>, SÉVERINE CASALIS<sup>1</sup> & MARINA LAGANARO<sup>2</sup>; <sup>1</sup>SCALab, *University of Lille, France*; <sup>2</sup>University of Geneva, *Switzerland*

Most of our knowledge on the time-course of reading is based on the lexical decision task, with very few electrophysiological studies using reading aloud. Recently, Mahé et al. (2015) have revealed that only low-level visual processes are common to the two tasks, with different electrophysiological patterns as early as the N170 component. Such pattern of data questions the use of the lexical decision task as an appropriate paradigm to investigate reading processes. This question is of particular relevance in the investigation of the time course of print processing impairments in developmental dyslexia, which has been mostly performed using lexical decision tasks.

The aim of the present study was thus to compare the ERP correlates of word reading in dyslexic adults relative to expert readers across lexical decision and reading aloud tasks in order to determine how the tasks modulate the intergroup differences. 22 dyslexic adults and 27 matched expert readers performed a lexical decision task and a reading aloud task on a matched material in the two tasks. EEG was recorded continuously using 128 channels. Behavioral results revealed slower RTs in dyslexic compared to expert readers in both tasks. Amplitude waveform analysis and topographic analysis performed on ERP data from the stimulus onset to 400 ms after revealed a Group\*Task interaction around 300 ms after word presentation (i.e., after the N200 time window), with significant differences between the two groups in reading aloud but not in lexical decision. Taken together, the present data extend the between task difference in the time course of print processing observed by Mahé et al. (2015) to a group of dyslexic readers. Importantly, the reading aloud task appear to highlight the impairments of dyslexic readers during printed word processing beyond the orthographic processes associated to the N2 component better than the lexical decision.

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.. 13:50 – 14:10 (250) ..

**The involvement of procedural learning in developmental dyslexia.** YAFIT GABAY; *University of Haifa, Israel*

The underlying biological and cognitive causes of developmental dyslexia remain under extensive debate despite decades of research. Although the emphasis has been on phonological deficits (i.e., in use of speech building blocks like [b] vs. [p] in bat vs. pat), there is growing evidence of more general procedural learning impairments in dyslexia. It is not yet known how procedural learning deficits might relate to phonological deficits; existing accounts emphasize motor and skill-acquisition functions associated with procedural learning systems. However, the neural learning systems thought to contribute to procedural learning have diverse non-motor roles, including involvement in acquiring perceptual categories. Intriguingly, perceptual category learning is highly significant in the development of robust speech representations to support phonological processing. In this talk I will describe a series of studies examining procedural learning mechanisms in individuals with developmental dyslexia. Specifically, I will show that critical aspects important for phonetic category learning such as segmentation and categorization are impaired in dyslexia and thus could affect the acquisition of phonological representations. Whereas phonological processing impairments have been emphasized as the cause of dyslexia, the current approach suggest that learning perceptual representations through procedural learning is impaired in dyslexia and could contribute to phonological deficits with subsequent negative effects on language acquisition and reading. I will end the talk by presenting a novel learning paradigm that informs phonetic category learning and can be implemented in dyslexia research, describing future research directions.

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.. 14:10 – 14:30 (251) ..

**Predictions of children's reading comprehension from executive function measures: a longitudinal study.** ZOE BABLEKOU & SOFIA CHATZIGEORGIOU; *Aristotle University of Thessaloniki, Greece*

The present study examined contributions of working memory (WM) and executive operations to children's reading comprehension in Greek. We investigated whether (i) WM and (ii) executive performance in kindergarten would predict children's reading performance (decoding, fluency, syntactic ability, and comprehension) at the end of grade 1. Working memory measures derived from the Baddeley and Hitch (1974) model and performance was evaluated with the Working Memory Test Battery for Children (WMTB-C, Pickering & Gathercole,

2001), translated from English to Greek and appropriately adapted (Chrysochoou, 2006; Chrysochoou & Bablekou, 2010). The executive measures were based on the PASS (Planning-Attention-Simultaneous processing-Successive processing) theory of intelligence and were evaluated with the Standard Battery of the Das-Naglieri Cognitive Assessment System (D-N CAS; Naglieri & Das, 1997), translated from English to Greek and appropriately adapted for the purposes of this project. Reading ability was assessed with the Detection Scale of Reading Ability and Disability (new-TELA, Padeliadu & Sideridis, under publication). Fifty eight preschool children (24 girls and 34 boys) participated and were assessed twice during the study: at the end of kindergarten (mean age=70.7 months; range=66–77 months; SD=2.96) and at the end of grade 1 (mean age=81.9 months; range=76–89; SD=3.31). Multiple regression analyses showed that decoding was predicted by the phonological loop measures of WM. Syntactic ability was predicted by the central executive and visuo-spatial sketch pad WM measures. Reading fluency was predicted by the phonological loop, visuo-spatial sketch pad and attention measures. Finally, reading comprehension was predicted by phonological loop measures combined with the central executive and the simultaneous process measures. The shared elements of the Baddeley and Hitch and the Das et al. models are discussed. The data also shed light into the executive processes underlying reading.

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## Memory and Learning H8, Wednesday, 12:50 – 14:30

.. 12:50 – 13:10 (252) ..

**Cognitive conflicts impair free recall performance.** MICHÈLE FRIEDLI & BEAT MEIER; *Institute of Psychology, University of Bern, Switzerland*

Encountering a cognitive conflict impairs immediate task performance, but the long-term consequences are not clear. The current study was designed to investigate the impact of two types of cognitive conflict, that is, task switching (vs. task repetition) and stimulus incongruence (vs. congruence) on subsequent free recall performance. In an incidental study phase, participants had to switch between two semantic classification tasks with two simultaneously presented words. In one condition the stimuli were presented auditorily, in another condition they were presented visually. They consisted either of two identical words (rendering

them congruent) or two different words (rendering them incongruent). Following the task-switching phase, participants completed a surprise free recall test. The results showed lower recall performance for switch compared to repetition stimuli. Moreover, congruent stimuli were better remembered than incongruent stimuli. Our results indicate that cognitive conflicts consistently hurt subsequent memory performance.

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.. 13:10 – 13:30 (253) ..

**Inhibition of motor sequences in memory.** TOBIAS TEMPEL & CHRISTIAN FRINGS; *University of Trier, Germany*

We investigated directed forgetting of motor sequences. Participants subsequently learned three sets of sequential finger movements. Each set consisted of four sequences comprising the movement of four fingers. Initially, participants were informed that they were going to be instructed to either retain or forget an item sets after studying it. Two groups were compared. The remember group did not receive a forget instruction for any of the three sets, whereas the forget group was asked to forget the items of set 2 immediately after it had been studied but was supposed to retain items of the previously learned set 1 as well as the subsequently learned set 3. In a final recall test, both groups were tested on all three lists. A significant interaction between group and item set reflected a benefit regarding recall of items learned after receiving a forget instruction for set 2 (i.e. set 3) whereas recall of set 2 items was impaired. Thus, costs and benefits of directed forgetting occurred, replicating findings from a previous study (Tempel & Frings, 2016) using motor sequences as item material. The present results additionally suggest that inhibition affected the to-be-forgotten item set because selective directed forgetting of only the second but not the initially encoded set is incompatible with alternative theories, such as, a model assuming that a mental context change after receiving a forget instruction accounts for directed-forgetting costs.

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.. 13:30 – 13:50 (254) ..

**Social statistical learning.** DEZSO NEMETH<sup>1,2</sup>, KATINKA DOBROTKA<sup>1</sup>, VIKTORIA DECSI<sup>1</sup>, IVETT PODINA<sup>1</sup> & KAROLINA JANACSEK<sup>1,2</sup>; <sup>1</sup>*Eotvos Lorand University, Hungary*; <sup>2</sup>*Hungarian Academy of Sciences*

One of the central questions in psychology concerns the mere presence of others and how the social context influences our actions and cognitive processes. Two social impacts are widely known in the literature: 1) people tend to align personal atti-

tudes with those of their social groups, and 2) the presence of others can lead to better performance in certain tasks. The relationship between learning/memory processes and social context has not been investigated yet, although companions can fundamentally change our coding, retrieval, and consolidation processes. Our study aims to fill this gap by investigating how the presence of another person influences one aspect of non-declarative memory, namely implicit statistical learning, measured by a probabilistic sequence learning task. We also explored whether participants spontaneously learn their partner's sequence as a result of social alignment. Testing was divided into two sessions (with 24-hour delay); two participants took place in the social condition and one participant in the control condition. Our results show that social context did not influence implicit sequence learning performance in the first session but led to better consolidation after the 24-hour delay. Moreover, participants have learned the sequence of the other participant without any instruction. These findings suggest an interaction between non-declarative memory consolidation and the presence of others, and are further relevant not only in social psychology but also can help in the deeper understanding of memory encoding, retrieval, and consolidation.

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.. 13:50 – 14:10 (255) ..

**Re-thinking domain generality vs. domain specificity in statistical learning: the interaction of modality and input characteristics.**

NOAM SIEGELMAN<sup>1</sup>, LOUISA BOGAERTS<sup>1</sup> & RAM FROST<sup>1,2,3</sup>; <sup>1</sup>*Hebrew University of Jerusalem, Israel*; <sup>2</sup>*Haskins Laboratories, New Haven, CT, USA*; <sup>3</sup>*BCBL, Basque center of Cognition, Brain and Language, San Sebastian, Spain*

Statistical Learning (SL) is typically considered to be a domain-general mechanism by which cognitive systems discover the underlying statistical regularities in the input. Recent studies showed, however, that individual abilities in visual and auditory SL tasks, although stable over time, are not correlated. This finding is consistent with an alternative view, according to which SL displays characteristics of domain specificity (Frost, Armstrong, Siegelman, & Christiansen, 2015). But note that whereas most visual SL tasks involve the processing of abstract shapes, auditory tasks are very often based on linguistic units - syllables. Here we entertain the hypothesis that the type of material used (i.e., verbal/non-verbal), and its interaction with the modality of presentation (i.e., visual/auditory) can account, at least to some extent, for the lack of correlation in performance between visual and auditory SL tasks. More specifically, audit-

ory tasks with verbal material substantially involve prior knowledge, stemming from each individual's prior linguistic experience, whereas no such influence exists when processing non-verbal material. We present evidence supporting this claim, showing that auditory-verbal tasks display striking item-specific effects resulting in low correlations between test items. In contrast, non-verbal tasks in both modalities display high correlations between items. In addition, we present new data suggesting that individual performance in auditory and visual tasks is highly correlated once both tasks involve non-verbal material. We discuss the methodological and theoretical implications of this unique interaction between modality and type of material, focusing on models of domain generality/specificity of SL, as well as on the relation between SL performance and linguistic abilities.  
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## Symposium: Self-monitoring in Speech Production

### H1, Wednesday, 14:40 – 16:20

.. 14:40 – 15:00 (256) ..

**Towards an integrated psycholinguistic, neurolinguistic, sensorimotor framework for speech production.** GREGORY HICKOK; *UC Irvine, United States of America*

Speech production has been studied within a number of traditions including linguistics, psycholinguistics, motor control, neuropsychology, and neuroscience. These traditions have had limited interaction, ostensibly because they target different levels of speech production or different dimensions such as representation, processing, or implementation. However, closer examination of reveals a substantial convergence of ideas across the traditions and recent proposals have suggested that an integrated approach may help move the field forward. The present article reviews one such attempt at integration, the state feedback control model and its descendent, the hierarchical state feedback control model. Also considered is how phoneme-level representations might fit in the context of the model.  
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.. 15:00 – 15:20 (257) ..

**Production-based monitoring and control.** NAZBANOU NOZARI; *Johns Hopkins University, United States of America*

The most widely-accepted account of speech self-monitoring, the perceptual loop, assumes that

speakers use the comprehension system to monitor their production. While there is some support for the role of the comprehension system in monitoring, certain findings question the viability of a comprehension-based monitor as the main monitoring mechanism for speech. These findings include a double dissociation between comprehension and self-monitoring abilities in individuals with brain damage, as well as a dissociation between the neural regions involved in comprehension and self-monitoring. On the other hand, empirical evidence from both children and individuals with brain damage points to a close link between production and self-monitoring abilities, suggesting a pivotal role for the production system in self-monitoring of speech.

I propose the conflict-based monitor, an example of a production-based monitor, as a monitoring model in which the amount of conflict between competing representations is used to determine the probability of an error. Using simulations, I will discuss the predictions of a production-based monitor and will verify those predictions by empirical evidence. I will argue that the correspondence between the model predictions and the empirical data supports a production-based monitor as the main mechanism for speech monitoring with comprehension as a complementary mechanism.  
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.. 15:20 – 15:40 (258) ..

**Joint monitoring in dialogue.** MARTIN JOHN PICKERING; *University of Edinburgh, United Kingdom*  
NA  
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.. 15:40 – 16:00 (259) ..

**Functional brain mapping of verbal self-monitoring.** HANNA S. GAUVIN<sup>1</sup> & ROBERT J. HARTSUIKER<sup>2</sup>; <sup>1</sup>*Queensland University of Technology, Australia*; <sup>2</sup>*Ghent University*

Currently there is no theory that can fully account for verbal monitoring during speech production and perception. The three presented theories on verbal monitoring all differ in scope and to what degree they take have been supported by behavioural and neuroimaging findings, with each their strengths and weaknesses.

The conflict monitoring theory covers monitoring during lexical and phonological selection, by means of a domain general conflict monitoring process. The conflict monitoring model received support from behavioural data from error production and error detection, and from EEG and fMRI data showing domain general ERP responses and increased ACC/pre-SMA activation in error and high conflict trials.



The Hierarchical State Feedback Control (HSFC) model specifically deals with the interplay between phonemes, the articulatory system and the auditory system. It deals with both the sensory input and the motor output at those levels. The HSFC is highly specified with respect to neurological tracks and sites involved at the specific steps of monitoring, and is formed on the basis of a neurolinguistic data. Additionally, theoretical constructs from research into sensory-motor integration are applied to the speech production system. Evidence for the proposed role of efference copies in speech production receives support from auditory cortex MEG data.

The forward modelling theory covers verbal monitoring during speech production and perception, by constantly creating and comparing predictions. EEG and eye tracking studies confirm a role for prediction during perception.

In the current presentation, we discuss latest findings from neurolinguistic literature and how these data match with the current models. We explore the feasibility of a verbal monitoring model which covers speech production and perception, from the conceptual to the articulatory level. Aspects from the models above which are supported by neuroimaging data are integrated to form a new model.

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## Symposium: Timing in Cognitive Multitasking: Different Perspectives and Approaches H2, Wednesday, 14:40 – 16:20

.. 14:40 – 15:00 (260) ..

**Prediction for “when” and “what” jointly helps tasks separation in multitasking?** FANG ZHAO<sup>1</sup>, ROBERT GASCHLER<sup>1</sup>, EVA RÖTTGER<sup>2</sup>, HILDE HAIDER<sup>2</sup> & ROLAND THOMASCHKE<sup>3</sup>; <sup>1</sup>*FernUniversität in Hagen, Germany*; <sup>2</sup>*Universität zu Köln*; <sup>3</sup>*Albert-Ludwigs-Universität Freiburg*

In laboratory multitasking settings, participants cannot prepare ahead when and what event (stimulus / event) will be present, as the stimulus sequence and SOA are mostly randomized. Here we test to what extent predictability of stimulus sequence and of timing can support performance in multitasking by fostering the separation of representations involved in the two tasks. In a dual-task condition, task separation may ease the problem of dysfunctional across-task bindings of stimuli and

responses (Logan & Gordon, 2001). When time is predictable, task separation may occur, which helps to increase within-task sequence learning by decreasing across-task binding of stimuli and response events. Two experiments on sequential timing using a dual-task serial reaction time paradigm were conducted. In Experiment 1, participants (N = 28) were firstly explicitly trained to learn a 4-element stimulus sequence and a 4-element timing sequence. Then they were tested in random timing or random stimulus blocks. ONLY predictable stimulus triggered quick responses in multitasking. Participants tended to separate tasks only when the time is predictable. In Experiment 2, participants (N = 30) were asked to learn a 4-element stimulus sequence and a 4-element timing sequence. Different from Exp 1, predictable stimulus and timing lead to quick response. However, predictable timing does NOT help people to keep task representations apart. To sum up, RTs can be reduced in dual tasking with predictable timing or stimulus. However, after learning the time sequence, people may not attempt to separate the two tasks in order to avoid dual-task cost.

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.. 15:00 – 15:20 (261) ..

**Time-based expectancy in temporally structured task switching.** STEFANIE AUFSCHNAITER<sup>1</sup>, ANDREA KIESEL<sup>1</sup>, GESINE DREIBACH<sup>2</sup>, DORIT WENKE<sup>3</sup> & ROLAND THOMASCHKE<sup>1</sup>; <sup>1</sup>*University of Freiburg, Germany*; <sup>2</sup>*University of Regensburg, Germany*; <sup>3</sup>*Private University of Applied Sciences Göttingen, Germany*

In many situations we have to switch between different tasks. Previous research has shown that task switching leads to relatively slow responses and high error rates. In many real life task switching contexts, tasks are not randomly distributed over time, but the temporal distribution of tasks carries information. Often the delay before a task predicts to some degree which task it will be, like when a longer browser loading time for a website makes a loading error, and hence the search for an alternative website more likely. The present study investigated for the first time, whether and how humans adapt to such temporal regularities. In a series of 5 experiments participants had to classify numbers either as odd or even or smaller or larger than five. The color of target numbers indicated, which of the two tasks the participants had to perform on that number. The target stimuli were preceded by either a short interval (500 ms) or a long interval (1500 ms). Crucially, the duration of this interval predicted with different probabilities the task (90 % in Exp. 1; 80 % in Exp. 2; and 70 % in Exp. 3), respectively the task transition (i.e., repetition or switch; 90 % in Exp. 4; and 80 % in Exp. 5). Parti-

cipants adapted their response behavior to the predictability of the task, for all tested degrees of predictability (70, 80 and 90%), but they adapted only for 90 % predictability when task switches were temporally predictable. Participants did not become aware of the temporal regularities throughout the experiment. Thus, the adaptation was implicit. Our findings reveal for the first time that participants benefit not primarily from long preparation intervals, but that the predictability of these intervals plays a crucial role concerning the adjustment of anticipatory cognitive control in task switching.

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.. 15:20 – 15:40 (262) ..

**Is Multi-Tasking Easier for Experts or Skilled People?** RALF T KRAMPE, DIETMAR HESTER-MANN & ANNE-MEREL MEIJER; *Brain & Cognition Group, KU Leuven, Belgium*

Since the dawn of multi-tasking research theoreticians have argued that real-life skill or expertise in one component task reduce interference through automatization (Kinsbourne & Hicks, 1978). Kinsbourne's example was a pianist reading text aloud while performing music. Recent studies praise spin-off cognitive control benefits of bilingualism and musical skill for task-set switching and coordination (Amer et al, 2013).

We conducted several studies, in which novices, accomplished amateurs, and experts (musicians, martial artists) performed tasks from their domain of skill (movement timing, postural control) along with an unfamiliar working memory task. In all cases dual-task costs in the WM task were as high or higher in skilled participants or experts compared with novices. In line with the modal view of expertise (Chase & Ericsson, 1982) our findings suggest that real-life skill and expertise rely on different mechanisms rather than on automatized novice mechanisms. Apparently, expert mechanisms pose attentional demands and they do not confer general multi-tasking abilities.

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.. 15:40 – 16:00 (263) ..

**To what degree is cognitive control involved in low-level timing and does this dependency change with age and expertise?** ANNE MEREL MEIJER & RALF THOMAS KRAMPE; *KU Leuven, Belgium*

Extant models of timing state that control of simple repetitive movements at intervals below 1s is a rather automatic process that does not depend on cognitive functions. However, studies concerning multitasking of low-level timing and a secondary cognitive task typically find dual-task interference in timing. To investigate whether this dual-task interference changes in the context of age and expertise, we had young and older adults, both musically trained and novices, simultaneously perform a tapping task and a working memory task. In a different study, we had musically untrained young and older adults perform a tapping task and a cognitive control task in dual-task settings, and systematically varied the cognitive control demands of the secondary task by adding a task switch component. Results indicated that dual-task costs increased with age in the novice participants, but tapping in musical amateurs was not affected by age or by the secondary task. The non-switch secondary task had no effect on timing for both young and older adults, but the switch task affected timing performance in older adults. These findings indicate that dual-task interference in timing in older adults is not caused by multi-tasking per se, but depends on the cognitive control demands of the concurrent task and musical training. Patterns of local interference in the timing of individual intervals suggest that the role of cognitive control is to maintain representations of target durations during interval production.

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.. 16:00 – 16:20 (264) ..

**Anticipating the optimal timing to process the secondary task in a Dual-Task Paradigm.** MANDY ROHEGER, ANJA OPHEY & HILDE HAIDER; *University of Cologne, Germany*

In a recently published paper, Israel and Cohen (2011) showed that extensive practice of two concurrently conducted tasks can entirely eliminate dual-task costs. However, this was only the case when no Stimulus-Onset Asynchrony was presented (SOA = 0). When the authors administered their participants into a dual-task situation with differing SOAs (0, 50, 150, or 800ms), their performance clearly reflected dual-task costs. Two different, not mutually exclusive explanations can account for these findings. On the one hand, Miller, Ulrich, and Rolke (2009) assume that short SOAs lead participants to adopt a parallel processing strategy while a serial processing strategy is more efficient

with longer SOAs. On the other hand, the findings of Adams (1962) suggest that dual-task costs might result from the statistical structure of the SOAs within the training blocks. This distribution leads participants to expect certain classes of SOAs. If the SOA is shorter than expected, the participants are less prepared and thus RTs are longer.

In two experiments, we tested this latter assumption by manipulating the frequency of different SOA-intervals (100ms, 300ms, 800ms in Experiment 1; 300ms, 500ms, 1000ms in Experiment 2). In both experiments, participants either received 80% of the shortest SOA and only 20% of the longer SOAs, or vice versa, 80% of the longest SOAs and 20% of the shorter SOAs. The results of both experiments revealed that with the shortest SOA, participants with mostly short SOAs were faster than participants with mostly long SOAs. Overall, the findings suggest that participants learn to anticipate the optimal time interval when to start processing the secondary task.

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## Symposium: Applications of Embodied Cognition to STEM Education

H5, Wednesday, 14:40 – 16:20

.. 14:40 – 15:00 (265) ..

### Mathematical Insight and Proof via Action-Cognition Transduction and Grounded Language.

MITCHELL J. NATHAN & CANDACE WALKINGTON; NA

NA

Email:

.. 15:00 – 15:20 (266) ..

### RoomQuake: Using Embodiment and Grounding in Elementary School Science.

ALLISON J JAEGER<sup>1</sup>, JENNIFER WILEY<sup>2</sup> & TOM MOHER<sup>2</sup>; <sup>1</sup>Temple University, United States of America; <sup>2</sup>University of Illinois at Chicago

Spatial skills predict learning in science, technology, engineering and mathematics (STEM) and may be especially important for understanding concepts that require visualizing, manipulating or animating spatial information. Because of the recent emphasis on STEM, it is important to identify conditions that may allow students with weaker spatial skills to succeed in STEM disciplines. Desktop simulations, while useful in representing the scientific phenomena, do not em-

body or contextualize the spatial aspects of the phenomena. Alternatively, Embedded Phenomena are classroom-based simulation technologies that combine embodiment and grounded experience to support learning in science. The current study investigated the effectiveness of an Embedded Phenomena activity for learning about earthquakes, and whether the effectiveness was impacted by individual differences in spatial skills. In the embedded condition, 15 earthquake events were simulated within the classroom space and students enacted the computation of epicenters with strings and their bodies. In the non-embedded condition, students completed the same activities with the same instruction, however the epicenter computation activities were done on maps and not with students' bodies. Results demonstrated an overall benefit for the embedded condition such that greater learning gains were found compared to the non-embedded condition. Additionally, while spatial skill did constrain learning in the non-embedded condition, the effect of spatial skills was reduced when the activity was embedded and enacted within classroom space. These results suggest that grounding an activity in an embodied experience may lessen the demands of mentally representing the phenomena, which may be critical for supporting understanding for low-spatial students.

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.. 15:20 – 15:40 (267) ..

### How to Get the Point: Spatial Language and Gesture Can Help Teach Topographic Maps.

STEVEN MARC WEISBERG<sup>1</sup>, KINNARI ATIT<sup>2</sup>, THOMAS F. SHIPLEY<sup>3</sup> & NORA S. NEWCOMBE<sup>3</sup>; <sup>1</sup>University of Pennsylvania, United States of America; <sup>2</sup>Northwestern University, United States of America; <sup>3</sup>Temple University, United States of America

Representing 3D information is challenging. Our primary representational tools - diagrams, language, and gesture - each have unique strengths that aid in representing 3D and spatiotemporal information, but each also has significant weaknesses. Here, we explored how spatial language and gesture influences the information processed from topographic maps. We use topographic maps that represent 3D terrain information using 2D contour lines, compressing the 3D information onto 2D space by discretizing metric information about the Z-dimension and providing it symbolically. In a set of studies, we assessed the effectiveness of spatial language and gesture for conveying aspects of topographic map content. In one study, we observed that participants who used the term elevation (emphasizing the symbolic information about the Z-dimension) performed better. In another study, we found that point-and-trace gestures highlighting the contour lines led to better topographic map

comprehension than basic textbook-type instruction; instruction with iconic gestures, which represent topological features such as hills and valleys, did not provide a significant boost. Combining spatial language and gesture in a third study revealed an interaction between spatial language and gesture. In instruction, key phrases focused either on visualizing the contour lines and imagining the terrain in 3D (Visualizing condition), or on analyzing the contour lines to determine how specific numerical values of elevation change (Analyzing condition). Tested on novel maps, participants differentially succeeded on test items requiring either visualizing shapes or analyzing elevation. Results augment our understanding of how communication modalities work together and how spatial information can best be conveyed.

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.. 15:40 – 16:00 (268) ..

**Supporting Learning about Molecular Structure Through Embodied Actions.** MIKE STIEFF & DANE DESUTTER; *University of Illinois-Chicago, United States of America*

Theories of embodied cognition reject wholly computational models of cognition to assert that cognition is grounded in the human form and supported by motoric action. While research continues to explore the validity of this assertion, learning environments and pedagogies informed by theories of embodied cognition have begun to demonstrate efficacy. These designs have proven to be particularly effective for facilitating learning in science, technology, engineering, and mathematics (STEM) disciplines. Here, we present evidence that learner-produced gestures are specifically effective for supporting spatial thinking in science. In two studies we examined the effectiveness of choreographed gestures for helping students learn how to identify complex spatial relationships in molecular structures and to represent those relationships in two-dimensional diagrams. In Study 1, we demonstrate that students trained to make gestures that represent spatial relationships and perform spatial operations make significant gains understanding stereochemistry concepts. In Study 2, we demonstrate that these gains result specifically from motoric action by learners while learning about spatial relationships. Together, the results indicate that (1) motoric actions and not static gestures benefit spatial thinking and (2) this benefit results from using motoric actions during learning as opposed to using them while problem solving. We use these findings to propose new design principles for learning technologies that couple motoric actions with dynamic visualizations to improve learning outcomes in STEM domains.

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## Symposium: Recent Developments in Measuring and Testing Awareness

### H6, Wednesday, 14:40 – 16:20

.. 14:40 – 15:00 (269) ..

**A model-comparison approach to testing awareness in implicit learning research.** MIGUEL A. VADILLO<sup>1</sup>, DOUGLAS LINSSEN<sup>2</sup>, STEPHANIE PARSONS<sup>2</sup>, CRISTINA ORGAZ<sup>3</sup> & DAVID R. SHANKS<sup>2</sup>; <sup>1</sup>*Universidad Autónoma de Madrid, Spain*; <sup>2</sup>*University College London, UK*; <sup>3</sup>*Universidad Nacional de Educación a Distancia, Spain*

Some complex forms of learning are typically attributed to the operation of unconscious processes. For instance, research on probabilistic cueing of visual attention suggests that if a search target appears more often in some locations than in others, we detect it more easily in the most probable locations, even if we lack any conscious knowledge of this regularity. Unfortunately, establishing that people are truly unaware of something is a daunting challenge, from a methodological point of view. The research methods and statistics used in experimental psychology were designed to test the hypothesis that something happens, but they perform very poorly when one's purpose is to test the hypothesis that something (like awareness) is absent. In the present work we illustrate this problem taking probabilistic cueing of visual attention as a case study. A comprehensive review and meta-analysis of the studies conducted so far with this experimental paradigm shows that the evidence supporting the absence of awareness is weak. A Bayesian analysis reveals that the sample sizes, procedures and analyses used in these studies are unable to yield strong evidence for the absence of awareness. A promising alternative to traditional methods is to test whether participants' performance is better fitted by a model assuming absence of awareness or by an otherwise identical model assuming that participants are perfectly aware of the regularities driving performance. Our initial results with this method suggest that the performance of most participants in the probabilistic cueing task is driven by conscious processes, although a minority of participants might be showing genuine implicit learning.

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.. 15:00 – 15:20 (270) ..

**Methods to assess objective awareness of a stimulus: overview, promises, pitfalls.** PIETER MOORS; *KU Leuven, Belgium*

An approach that remains popular within awareness research is the classic dissociation paradigm in which unconscious processing of a stimulus is assessed by observing an effect of the subliminal stimulus on the target stimulus (e.g., through priming) while performance on detecting an aspect of the subliminal stimulus is at chance. A challenge for these so-called objective approaches to assessing subliminality is that one has to accept the null hypothesis of chance performance, a question for which classical frequentist null hypothesis testing is not appropriate. To address this, several Bayesian methods have been developed that allow to quantify evidence in favor of such a null hypothesis of chance performance. Each approach comes with their subtleties, however, sometimes rendering it difficult to apply these methods. In this talk, I will provide an overview of the current methods available, how they relate to each other, and the (dis)advantages they come with. I will also touch upon parameter estimation methods that are available, yet rarely discussed. In addition, I will briefly discuss that in this type of experiments chance performance at the individual level is typically difficult to detect given the number of trials that are used to assess chance performance.

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.. 15:20 – 15:40 (271) ..

**Liminal-prime vs. subliminal-prime paradigm in the study of unconscious processing: pros and cons.** DOMINIQUE LAMY & MAAYAN AVNEON; *Tel Aviv University, Israel*

The search for the limits of unconscious processing has yielded findings that seem to push the scope of unconscious processing very far beyond simple, low-level processing. These findings typically emanated from the subliminal-prime paradigm, in which the effect of a subliminal prime on behavior is measured first and invisibility of the prime is confirmed in a subsequent test. However, this paradigm has been criticized on several grounds. In particular, it does not allow comparing the impact of a stimulus when it is consciously perceived relative to when it is not, which renders the interpretation of small unconscious priming effects difficult. Recently, the liminal-prime paradigm, in which conscious perception of a liminal prime is measured on each trial concomitantly with priming, has been suggested as an alternative. Here, we adapt iconic demonstrations of unconscious semantic processing to the liminal-prime paradigm. We compare conscious and unconscious priming, while evaluating the effects on priming of three features inherent to this paradigm: a dual-task situation, allocation of temporal attention to the prime and task relevance of the prime.

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.. 15:40 – 16:00 (272) ..

**Exhaustiveness of subjective measures of awareness.** KRISTIAN SANDBERG; *Aarhus University, Denmark*

The debate on how to measure awareness behaviourally is not new, yet it has received a resurgence of interest within the last decade or so. In a series of studies, we have examined and compared a number of subjective and objective measures of awareness: the perceptual awareness scale, confidence ratings, post-decision wagering, the sense of control scale and the exclusion task. Overall, we find that a particular category of subjective measures - participant generated awareness scales - fare particularly well showing a strong and consistent relationship between subjective ratings and objective performance both within the visual and motor domain. Other subjective and objective measures, such as confidence ratings and exclusion tasks, also fare well and may be preferred in particular contexts. Next, we demonstrate that multiple measures of awareness indicate the presence of a window of subliminal perception. We use modelling within a signal detection framework to explain this window of subliminal perception, and we demonstrate how the positioning of type II criteria within this framework could explain part of the superior performance of participant generated scales compared to other subjective measures and exclusion tasks. Taken together, our findings allow us not only to make recommendations regarding which scales to use when examining subliminal perception, but they also provide a potential explanation of why this is observed and to which extent it can be expected to be found across a range of experimental contexts.

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.. 16:00 – 16:20 (273) ..

**Criterion contents and decision spaces in measuring visual awareness.** THOMAS SCHMIDT; *TU Kaiserslautern, Germany*

It is currently debated whether objective or subjective measures are more suitable for measuring perception. In this talk I argue that the more important question is what exact criterion content is reflected in a measure, that is, what aspect of the perceived stimulus the participant is actually using to perform the task. A second critical aspect is the decision space required by the task, and its commensurability with the respective measure of unconscious processing. Following Irvine (2014), I argue against a strong concept of "consciousness" as a unified "thing" ("Konsciousness"), and instead vote for a more descriptive concept that is essentially coextensive with the actual measurement process ("schmonsciousness").

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## Symposium: Prospective Memory: Recent Theoretical Advances and New Empirical Findings H8, Wednesday, 14:40 – 16:20

.. 14:40 – 15:00 (274) ..

**Why reminders work: Evidence for future-directed attention decoupling after the presentation of intention-related stimuli.** JAN RUMMEL; *Heidelberg University, Germany*

Prospective memory (PM) is an umbrella term for those cognitive processes that allow us to remember to execute an intention at the appropriate moment. This moment is often indicated by a target cue that occurs in the environment. It has been argued that two cognitive routes can lead to successful PM completion, that is, controlled attentional processing or spontaneous retrieval that is triggered by the occurrence of the target event (Einstein & McDaniel, 2007). In a typical event-based PM situation, the intention is encoded and then gets delayed during an intention retention phase, before time comes to execute the intention. In the presented study, I investigated how the presentation of reminders during the intention retention phase alters PM processing. For this purpose, two experimental groups of participants received PM instructions to respond to certain target words in a later to-be-performed ongoing task with a designated response. A control group performed the ongoing task alone. All participants performed a filler task after receiving the PM instructions but before performing the ongoing task, during which participants were asked to describe their thoughts from time to time. Participants of one experimental group were additionally presented with the intention-relevant target words during the filler task. Thought-probe results showed that these reminders initiated intention-related thoughts and the more such thoughts participants reported the higher was the likelihood that the intention was later fulfilled. Results demonstrate that reminders initiate future-oriented thoughts that are beneficial for PM performance.

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.. 15:00 – 15:20 (275) ..

**The role of cognitive load and suppression in commission errors.** PHILIPP SCHAPER & TOBIAS GRUNDGEIGER; *Universität Würzburg, Germany*

Prospective memory (PM) tasks often have to be retrieved and executed in response to a cue. If these intentions are executed after they are no longer relevant, they are considered as commission errors.

The dual mechanism account predicts that commission errors are the result of spontaneous retrieval of the intention and the failure to suppress the execution of the intention. A modified version of this account focuses on cognitive resource available during spontaneous retrieval. If sufficient resources are available the intention is tagged for possible suppression, otherwise the intention will be set for execution. We compared the predictions of both theories using a divided attention, slip, and baseline condition. First, participants were instructed about the PM task and executed it several times. Second, the PM task was declared finished, but no longer relevant cues still occurred in the ongoing task block. In the divided attention condition, an additional task reduced available cognitive resources, which should result in higher commission error rates as predicted by both theories. In the slip condition, we changed the response key mapping for the ongoing and PM task allowing the execution of commission errors by a twitch of the thumb. The dual mechanism account predicted high commission error rates for the slip condition, because timely suppression is impossible due to the easy access to the key. In contrast, the modified account predicts error rates similar to the baseline condition. We found a significantly higher rate of participants committing commission errors in the divided attention condition relative to the baseline. In contrast to the dual mechanism account and favouring the modified account, we observed no difference between the slip and the baseline condition. These results indicate that cognitive resources during the presentation is relevant for commission error occurrence while failed suppression is no prerequisite for commission errors.

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.. 15:20 – 15:40 (276) ..

**Effects of acute stress on prospective memory and intention deactivation.** MARCUS MÖSCHL<sup>1</sup>, RICO FISCHER<sup>2</sup>, FRANZISKA PLESSOW<sup>3,4</sup>, THOMAS GOSCHKE<sup>1</sup> & MORITZ WALSER<sup>1</sup>; <sup>1</sup>*Technische Universität Dresden, Dresden, Germany*; <sup>2</sup>*University of Greifswald, Greifswald, Germany*; <sup>3</sup>*Massachusetts General Hospital, Boston, USA*; <sup>4</sup>*Harvard Medical School, Boston, USA*

In everyday life we frequently rely on our abilities to postpone intentions until later occasions (prospective memory; PM) and to deactivate completed intentions even in stressful situations. Yet, little is known about the effects of acute stress on these abilities. We will present findings from two studies on the effects of acute stress on PM and intention deactivation under varying task demands. In both studies, participants underwent a standardized stress-induction protocol (i.e., Trier Social Stress Test or Maastricht Acute Stress Test), or a standardized control situation, before performing a

computerized PM task.

In the first study, we investigated the impact of acute stress on PM under increased demands on PM cue detection (monitoring for non-salient, non-focal PM cues).

In contrast to previous reports of unaffected PM under low demands (non-salient, focal PM cues), when demands on PM cue detection were sufficiently increased, acute stress led to a reduction in PM-monitoring costs while leaving PM performance intact. These findings suggest that, under high demands, acute stress shifts PM performance towards resource-saving processing strategies. At the same time, however, this shift might come at a cost of increased commission errors when processing demands during intention deactivation are increased (salient, focal PM cues).

Finally, we will show data from a second study, in which we investigated whether acute stress affects PM and intention deactivation under increased demands of concurrently performed ongoing tasks and will report on whether acute stress differently affects a) PM cue detection (prospective component of PM) and b) remembering the content of a delayed action (retrospective component of PM).

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.. 15:40 – 16:00 (277) ..

**Task Interference from Nonfocal Prospective Memory: An Indication of Delayed Ongoing Responding or Active Monitoring?** MARK ALAN MCDANIEL<sup>1</sup>, FRANCIS ANDERSON<sup>1</sup> & JAN RUMMEL<sup>2</sup>; <sup>1</sup>Washington University in St Louis, United States of America; <sup>2</sup>University of Heidelberg, Germany

#### Background

In prospective memory (PM) research, costs (slowed responding or decreases in accuracy) to the ongoing task when a PM task is present have typically been interpreted as implicating an attentionally demanding monitoring process. To inform this interpretation, Heathcote, Loft, and Remington (2015), using an accumulator model, found that PM related costs were associated with changes in a decision threshold parameter, which was interpreted as disfavoring a monitoring process and supporting a non-capacity consuming delayed responding strategy.

#### Method and Results

The present study combined both behavioral and modeling techniques, as well as embedded

parameter validation, to better illuminate the underlying processes involved in PM. We encouraged participants in separate groups to use either a delayed responding or a monitoring strategy during the PM phase of the experiment to establish behavioral and model parameter anchor points for each kind of PM process. The mon-

itoring strategy produced better PM performance than did a delayed responding strategy. Additionally, costs were lower in the monitoring strategy group, and there were minimal changes in the decision threshold parameter relative to the delayed responding group. These results imply that the instructions successfully produced different approaches to the PM task. Performance in these conditions was then compared to performance in a third group, a standard PM condition (given standard PM instructions). Importantly, both the behaviors (e.g., reaction-time costs of the PM task) and the modeling parameters observed in the standard PM group more closely reflected the patterns displayed in the monitoring-instruction group. Further, working memory capacity was significantly associated with PM performance.

#### Discussion

The results confirm that PM costs can be produced with either a delayed-responding or a monitoring strategy. However, when standard prospective memory instructions are presented, participants appear to engage a monitoring strategy, rather than depend on a non-capacity consuming delayed-responding strategy.

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.. 16:00 – 16:20 (278) ..

**The robust influence of action-coordination processes on event-based prospective memory.** ANN-KATRIN WESSLEIN<sup>1</sup>, JAN RUMMEL<sup>2</sup> & THORSTEN MEISER<sup>3</sup>; <sup>1</sup>University of Tübingen, Germany; <sup>2</sup>Heidelberg University, Germany; <sup>3</sup>University of Mannheim, Germany

Event-based prospective memory (PM) is the ability to remember to perform an intended action in response to a pre-defined environmental cue. Remarkably, in most event-based PM situations, the cue occurs while the individual is actively involved in another ongoing task which thus has to be interrupted (temporarily) for successful PM fulfillment. To gain insights into the processes associated with coordinating the PM task and the ongoing task, we recently proposed to experimentally vary the amount of response overlap between both tasks, showing that PM performance is better in high-overlap situations compared to low-overlap situations (Rummel, Wesslein, & Meiser, 2016). Note that according to microstructure models of event-based PM, this effect takes place at Stage 4, which comprises the processes associated with the coordination of the intended action and the demands of any currently ongoing task. Up to now, we demonstrated the robustness of this response-overlap effect in many experiments. Here, we report a series of experiments investigating the relation of the response-overlap effect and other stages of PM processing. Taken together, our find-

ings indicate that the Stage-4 processes of action coordination are largely independent from the cognitive processes of the Stages 1 to 3, namely (1) cue-noticing, (2) retrieval of the intended action, and (3) verification of the context.

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## Symposium: Recent Trends in Expertise Research

### H1, Wednesday, 16:35 – 18:15

.. 16:35 – 16:55 (279) ..

**Understanding Expertise: The necessity of a multi-disciplinary approach.** FERNAND GOBET; *University of Liverpool, United Kingdom*

Much progress has been made in cognitive psychology and neuroscience in understanding the mechanisms underpinning expert behaviour. Concurrently, expertise has been extensively studied in several other disciplines, in particular sociology, philosophy and artificial intelligence. However, there has been relatively little communication between these disciplines. This is regrettable, as many opportunities for cross-fertilisation have been missed and many contradictions between the disciplines ignored. For example, psychology has focused on performance-based expertise and emphasised the remarkable feats displayed by experts, while sociology has directed its attention to the shortcomings of reputation-based experts.

In this talk, I will first argue that several significant issues in each individual field are likely to be resolved when information is drawn from other fields. For example, most psychological theories about expertise are formulated in rather vague terms, and artificial intelligence offers tools that make it possible to develop more precise theories and thus provide better explanations. I will then address several overarching themes in the study of expertise that cut across disciplines and that would benefit from a multi-disciplinary approach. Building on the analysis developed in Gobet (2016), I will discuss rationality, knowledge, search and generativity. Addressing expertise from the viewpoint of several disciplines will highlight useful parallels and contradictions between them. This intellectually challenging exercise has not only theoretical implications, but also practical applications, for example with respect to education.

Two important weaknesses of current research into expertise is the fragmentation of knowledge, and the tendency to direct most resources toward a few issues (e.g. the question of knowing-how

vs. knowing-that in philosophy or the question of deliberate practice in psychology) whilst ignoring many other important issues. Integration across disciplines and multidisciplinary research offers the prospect of correcting these two weakness, and many others.

Reference

Gobet, F. (2015). *Understanding expertise: A multidisciplinary approach*. London: Palgrave.

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.. 16:55 – 17:15 (280) ..

**Neural Substrates of Expertise and Ageing: Domain-General and Domain-Specific Processes.**

RALF T KRAMPE<sup>1</sup>, STEPHAN SWINNEN<sup>2</sup> & NICOLE WENDEROTH<sup>3</sup>; <sup>1</sup>*Brain & Cognition Group, Psychology, KU Leuven, Belgium*; <sup>2</sup>*Movement Control & Neuroplasticity Group, Biomedical Sciences, KU Leuven, Belgium*; <sup>3</sup>*Neural Control of Movement, Health Sciences & Technology, ETH Zurich, Switzerland*

We determined the neural underpinnings of hierarchical timing control (HTC) from whole-brain functional scans collected in four groups of young (M=26.09 yr.) and older (M=61.62 yr.) professional musicians and age-matched novice controls (N=20 per group). Participants tapped rhythmic sequences with a wrist orthosis while lying supine in the scanner. Behavioral data showed the expected age x expertise interaction with older experts clearly outperforming young novices. Results from far-transfer tasks (Digit-Symbol, Digit-Span, Go-NOGo) indicated experts and novices were similar regarding domain-general processing speed, working memory, and cognitive control. fMRI data revealed a typical sensorimotor network for low-level timing. For complex tasks we found novices relying on posterior cerebellar Lobules (VI + Crus), Intraparietal Sulci, and a parietal-prefrontal network. Location of clusters and activation increases with task complexity point to typical domain-general networks, with demonstrated age-sensitivity particular in prefrontal regions. In contrast, experts relied on specific premotor and SM1 areas and this reliance on specific expert mechanisms was similar across task conditions.

To distinguish changes at the brain level in response to short-term practice from those of lifelong expertise we re-tested (including whole brain scans) our participants after six (novices), respectively one (experts) behavioral training sessions. Despite massive improvements in the novice group expert and novice neural mechanisms could still be dissociated.

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.. 17:15 – 17:35 (281) ..

**Developing Expertise in Radiology - Cognitive and Neural Mechanisms.** MERIM BILALIC; *Klagenfurt University, Austria / Northumbria University, UK*

Theoretical accounts assume that experienced radiologists have acquired vast knowledge of normal and abnormal radiological images. Once they encounter a new image, they automatically compare it with stored knowledge, quickly making a “global impression” of the image. This first impression leads quickly to suspicious regions. Less experienced radiologists lack this knowledge and have in turn much harder time identifying suspicious regions. Here I demonstrate that skilled perception in radiology bears resemblance to holistic processing in perpetual learning literature. Radiologists were expectedly much better than medical students at spotting lesions in thorax X-rays presented for only 200 milliseconds. However, their performance suffered significantly when the X-rays were presented in the inverted upside-down position. This indicates that holistic processes based on acquired knowledge play a crucial role in radiological expertise. The fMRI showed that both radiologists and medical students activated a number of brain areas to a similar extent. The differences were, however, specially pronounced in the inferotemporal areas around the fusiform gyrus. Radiologists demonstrated pronounced activation in this area whereas medical students lacked any significant activation within the area. Radiologists are rather good on spotting abnormalities in thorax X-Rays even when they were given only a split of second. Their performance seems to be based on a gestalt-like holistic process powered by their accumulated knowledge about normal and abnormal X-Rays. The fMRI results indicate that the fusiform gyrus is a possible neural basis of this remarkable skill. The fusiform gyrus is an important region for visual expertise and it hosts the Fusiform Face Area (FFA) that is responsible for face recognition. Face perception requires holistic processing just as thorax X-Rays and it seems that the same area is responsible for developing both skills.

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.. 17:35 – 17:55 (282) ..

**Modeling Cognitive Aging: Expertise Perspective.** NEMANJA VACI<sup>1</sup>, BARTOSZ GULA<sup>1</sup> & MERIM BILALIC<sup>1,2</sup>; <sup>1</sup>*Alpen-Adria University Klagenfurt, Austria*; <sup>2</sup>*Northumbria University, Newcastle, UK*

A considerable number of studies portray age-related decline in cognitive domains as a constant decrease over the later stage of life. These studies assume that otherwise healthy adults linearly decrease in general cognitive abilities, such as speed of cognitive processing, reasoning, and memory. Exceptions to this have been found in studies on the

domain-specific abilities of experts. These studies indicate that extensive practice and knowledge can counteract the age-related decline in the domains of expertise. The aim of this study was to investigate preserving effects of expertise in more details by investigating age-related changes of chess players.

To investigate the change in performance across players' age we used the big data modeling approach. The model that we built is a Bayesian cognitive latent variable model that estimates two main driving forces behind age-related changes: development (growth) and aging (decline). The model also combines age-related changes of performance with all other variables that can influence the change, such as periods of activity/inactivity of players.

Results show that development force is strong in the beginning, where any activity leads to the increase in the skill level. Eventually, the performance reaches the upper plateau and becomes stable. After the peak, the performance slowly declines, as the aging force becomes stronger than development force. Importantly, this decrease is not continuous and slowly approaches a lower plateau where it stabilizes. The interaction between the forces of development and aging does not produce a linear decline as previously assumed. It is also attenuated by the accumulated knowledge – experts' decline stabilizes earlier, they reach the lower plateau earlier and with a higher level of performance. Practice, activity, and lifelong acquisition of knowledge, in general, enable people to preserve their skill as they get older.

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## Symposium: Plasticity in Human Multitasking H2, Wednesday, 16:35 – 18:15

.. 16:35 – 16:55 (283) ..

**How does research on cognitive plasticity help understanding structure and flexibility of information processing in multitask settings?** HERMANN MÜLLER<sup>1</sup>, EDITA POLJAC<sup>2</sup>, ANDREA KIESEL<sup>2</sup> & IRING KOCH<sup>3</sup>; <sup>1</sup>*Justus Liebig University, Germany*; <sup>2</sup>*University of Freiburg*; <sup>3</sup>*RWTH Aachen*

People's ability to successfully operate in situations in which they have to solve two temporally overlapping tasks underlies long-term changes. This plasticity is partly due to more general changes in bodily and cognitive functioning, e.g. related to ageing, or the result of practice. Task switching research as well as dual-task research in the PRP tra-

dition have only recently started looking at these phenomena in more detail.

By contrast, age related changes in dual-tasking and training regimes to counteract possible decline have been in the focus of movement science, especially in setting that combine postural control and cognitive tasks. Despite their common interest in plasticity in dual tasking, cognitive psychology and movement science, both focus on different dependent variables. Cognitive psychology often relies on RT-based mental chronometry requiring strictly defined (button-press) tasks, whereas in movement science, complex kinematic features of continuous movements are studied. This preference for certain dependent measures in both research fields is also related to different conceptualizations of the interference of the tasks in a dual-task setting: The explanatory power of bottleneck models can only be exploited based on valid RT-data, whereas the interference between tasks in ecologically more valid settings including complex continuous movement tasks can (yet) only be described by less specific resource sharing models. This arguably impedes a confluence of knowledge across these research areas and disciplines.

Current methodological refinements will allow researchers to control tasks temporally more tightly and measure the timing of individual components even in complex continuous movements more precisely. This would be an invaluable benefit for multitasking research generally and for research on cognitive training effects in particular. According to our view, the interest in plasticity issues represent a common denominator across research on dual-task and task switching performance as well as across cognitive and movement sciences.

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.. 16:55 – 17:15 (284) ..

**How age affects multitasking during complex listening.** ANNELIES DEVESE, ALEXANDER DUDEK, ASTRID VAN WIERINGEN & JAN WOUTERS; KU Leuven, University of Leuven, Department of Neurosciences, ExpORL, Herestraat 49 bus 721, 3000 Leuven, Belgium

**Background** – Having a successful oral conversation does not only depend on good auditory processing abilities. During complex real-life listening situations, cognitive processes like attention, working memory and executive functions as well as the processing of visual (speech) cues are well known to influence perception. Taken together, listeners are required to multitask when facing the daily multitude of auditory and visual cues. The goal of this project is to investigate the effect of multitasking on speech understanding and the cognitive load during listening and to examine the effect of aging on these multitasking processes.

**Method** – Ecologically valid listening scenarios were developed by means of an audio-visual environment, including avatars uttering sentences. The complexity of the listening scenario was controlled in a quantitative way by gradually increasing the amount of tasks participants had to perform simultaneously. In the most difficult situation the participant executed a speech intelligibility task together with three secondary tasks: an auditory localization test, detection of the direction of sounds passing by and short-term memory storage of visual stimuli. Both normal hearing young and middle-aged adults were tested, allowing to investigate potential age-effects on real-life listening.

**Results & Discussion** – Results showed that for normal hearing adults of 18-30 years old, speech intelligibility was robust to the amount of tasks that had to be performed simultaneously. On the contrary, listening effort during speech-processing significantly increased when the listening situation became more complex. Furthermore, results revealed a more prominent impact of multitasking on listening effort for middle-aged adults.

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.. 17:15 – 17:35 (285) ..

**Multitasking practice and the efficient coding of several task representations in working memory.**

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Extended multitasking practice leads to the reduction of dual-task costs. While earlier studies attribute the mechanisms of such practice-related improvements to task automatization and to the improvement of component task processing, we assume that multitasking practice may lead to an efficient simultaneous coding and updating of several task representations in working memory. While single-task practice cannot improve the simultaneous coding and updating of several task representations in working memory, training with more than one task can do that. We report the findings of several experiments in which we manipulated the memory load and the difficulty to maintain simultaneously several task representations in working memory and show the impact of these manipulations on the results of extended multitasking training. The findings show that the efficiency of multitasking training strongly depends on the memory load and on the difficulty of task set maintenance in working memory during multitasking performance. This suggests that a core component of successful multitasking training is related to the optimization of the coding of task representations in working memory.

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.. 17:35 – 17:55 (286) ..

**Individual difference in task-switching training across the lifespan: Compensation effects in training and transfer outcomes.** JULIA KARBACH<sup>1</sup>, TANJA KÖNEN<sup>2,3</sup> & MARION SPENGLER<sup>4</sup>; <sup>1</sup>*Department of Psychology, University of Koblenz-Landau, Germany*; <sup>2</sup>*Center for Research on Individual Development and Adaptive Education of Children at Risk (IDeA), Frankfurt, Germany*; <sup>3</sup>*Department of Psychology, Goethe-University, Frankfurt, Germany*; <sup>4</sup>*Hector Research Institute of Education Sciences and Psychology, University of Tübingen, Germany*

**Background:** Training studies have shown that cognitive plasticity, that is the potential modifiability of a person's cognitive abilities, is considerable across the lifespan and extends to very old age. Cognitive training can result in significance performance improvements on the trained tasks, but also benefit performance on new untrained tasks (transfer). However, even though interventions can be very successful at the group level, individual differences in training gains tend to be large. Why do some individuals benefit more than others?

**Method:** In the present study, we investigated transfer of executive control training in children, (N=41, 8-10 years of age), younger adults (N=42, 18-26 years of age), and older adults (N=42, 62-76 years of age) in a pretest-training-posttest design.

**Results:** Latent change modeling showed a training-induced reduction of age differences and individual differences across training and transfer tasks in all age groups. Moreover, individuals with lower cognitive abilities at pretest showed larger training and transfer benefits after the training.

**Discussion:** These findings reveal a pattern of compensation effects with the largest training-induced improvements in participants who needed them the most.

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.. 17:55 – 18:15 (287) ..

**No evidence for transfer effects after process-based working memory training.** CLAUDIA CHRISTINA VON BASTIAN<sup>1</sup>, CARLA DE SIMONI<sup>2</sup> & SABRINA GUYE<sup>2</sup>; <sup>1</sup>*Bournemouth University, United Kingdom*; <sup>2</sup>*University of Zurich, Switzerland*

Can cognitive abilities such as reasoning and multitasking be improved through working memory training? After more than a decade of working memory training research, this question is still highly controversial. Inconsistent findings from prior studies have been discussed to be due to methodological issues such as small sample sizes, and inadequate controls and measures. In two studies, we examined the effectiveness of three working memory training interventions (binding or updating training in Study 1, and mixed paradigms in Study 2) in relatively large samples of

younger (Study 1) and older adults (Study 2) compared to active controls practicing visual search. Furthermore, we used multiple tasks to measure transfer to reasoning, inhibition, and task switching and mixing. Results were consistent across the two studies, with Bayesian analyses supporting the absence of transfer to any other cognitive ability – despite large practice effects in the trained tasks and strong correlations between training and transfer abilities. Therefore, we conclude that the repetitive practice of working memory tasks does not improve general cognitive performance.

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## Symposium: Working Memory from Childhood to Adulthood: What Influences Memory Performance?

H5, Wednesday, 16:35 – 18:15

.. 16:35 – 16:55 (288) ..

**Tracking the development of visuospatial memories with eye movements.** CANDICE MOREY, SILVANA MAREVA, JAROSLAW LELONKIEWICZ & NICOLAS CHEVALIER; *University of Edinburgh, United Kingdom*

The emergence of strategic verbal rehearsal at around 7 years of age is widely considered a major milestone in descriptions of the development of memory across childhood. Likewise, rehearsal is believed by many to be a crucial factor in explaining why memory improves with age. This apparent qualitative shift in mnemonic processes has also been characterized as a shift from passive visual to more active verbal mnemonic strategy use, leaving considerable uncertainty around whether children shift from visual to verbal strategies or, more broadly, from reactive to proactive strategies. However, no investigation of the development of overt spatial rehearsal has informed this explanation. In adults, sequential fixations toward to-be-remembered stimuli have previously been linked to serial recall accuracy (Tremblay, et al. 2006). We likewise measured serial spatial order reconstruction in adults plus groups of children 5-7 years old and 8-11 years old, while recording their eye movements. Adults' fixation durations to late-list items gradually decreased, consistent with the idea that they spend time during stimulus presentation rehearsing previously-presented stimuli (Lange & Engbert, 2013). In contrast, the youngest children overtly fixated late-list spatial positions longer than adults, suggesting that younger children are less

likely to engage in covert rehearsal during stimulus presentation. Sequential re-fixating during retention was related to recall accuracy in all age groups. The youngest children overtly fixated proportionally more of the to-be-remembered sequences than any other group, which is inconsistent with the idea that children passively do nothing to try to remember. They are most consistent with proposals that children's style of remembering shifts around age 7 from reactive cue-driven methods to proactive strategies, which may include cumulative rehearsal.

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.. 16:55 – 17:15 (289) ..

**Beyond Everything Going Up with Age: Unloading Central Attention.** NELSON COWAN; *University of Missouri, United States of America*

A perpetual problem with cognitive developmental research is the uninterpretable finding that every component of memory and ability increases with age in childhood, the "dull hypothesis.". In order to demonstrate a theoretically useful pattern, it is necessary to show some kind of dissociation between processes. In our past studies, we showed that visual working memory capability increased across the elementary school years after controlling for attentional filtering ability, rehearsal, encoding speed, and knowledge. By default, we could say that capacity increased with age. But is this capacity increase accounted for by an increase in pure attention, or in the ability to encode stimuli in such a way as to decrease the need for attention? In new research on memory for two modalities at once, we show that the latter is the case.

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.. 17:15 – 17:35 (290) ..

**Working memory capacity and the role of attention over development.** ANDRIA SHIMI; *Cyprus Institute of Neurology & Genetics, Cyprus*

Visual working memory (VWM) is limited in capacity, and differentially so over the lifespan. The neurodevelopmental mechanisms by which attentional control constrains the limits of VWM remain poorly understood, but assessing how participants of different ages encode and maintain mnemonic representations can elucidate the interplay between the two processes. Here I will present data from a series of complementary experiments targeting attention and VWM dynamics during childhood, which in turn can inform the adult end-state: first, developmental differences in attentional control mediate differences in the efficiency of encoding and maintenance in VWM in children demonstrating a behavioural dissociation between attentional processes to external percepts and internal

representations; second, similarities and differences in the neural mechanisms supporting the means by which younger and older participants orient attention to representations in memory reveal a neural dissociation between attentional shifts prior to encoding and during maintenance; finally, individual differences in the ability to bias representations, predict VWM capacity in childhood. Collectively, these findings reveal how attentional control boosts encoding and maintenance in VWM and shed light onto the mechanisms driving improvements in VWM limits from childhood into adulthood.

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.. 17:35 – 17:55 (291) ..

**Current versus prospective representations in working memory.** CHRISTIAN N. L. OLIVERS; *Vrije Universiteit Amsterdam, Netherlands, The*

The maintenance and implementation of the current task goal is typically seen as the primary function of working memory. However, flexible planning and sequencing of multiple tasks also requires the representation of future goals, and thus the maintenance of prospective task representations. Little is known about the difference between currently and prospectively relevant memory representations. The findings so far suggest that the first is "active" (i.e. represented as firing activity), while the second is "silent" or "passive", or "hidden" (presumably represented through synaptic weight changes). I will present results from a paradigm involving sequences of two visual search tasks, allowing us to directly compare the representations of current and future search goals. First, using EEG time-frequency measures we could track the current priority of the first search target over the second during the delay period prior to the first search, followed by a switch after the first search. Interestingly, the findings suggest an active representation also for the prospective search goal. Second, fMRI multi-voxel pattern classification of object-selective cortex revealed that the current versus prospective status of the memory interacted with the category-specific representation of the search target, such that current and future search goals became separated in representational space. Here too, information about the second, prospective goal could be reliably decoded during the first search. Furthermore, while posterior cortex remained sensitive to target category, prefrontal cortex only represented target status. Taken together, our results reveal how the brain shields current from future targets and vice versa.

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.. 17:55 – 18:15 (292) ..

**Working memory and distraction in healthy ageing.** FIONA MCNAB; *University of York, United Kingdom*

The effectiveness of distractor-filtering is a potentially important determinant of working memory capacity (WMC). However, a distinction between the contributions of distractor-filtering at WM encoding as opposed to filtering during maintenance has not been made and the assumption is that these rely on the same mechanism. Within 2 experiments, 1 conducted in the laboratory with 21 participants, and the other played as a game on smartphones (n = 3,247) we measured WMC without distractors, as well as WM with distractors during encoding or during the delay period. Despite differences in experimental setting and paradigm design between the 2 studies, we show a unique contribution to WMC from both encoding and delay distractor performance in both experiments, while controlling for performance in the absence of distraction. Thus, we show a dissociation between encoding and delay distractor-filtering, indicating that separate mechanisms may contribute to WMC.

A weakened ability to effectively resist distraction is a potential basis for reduced WMC with healthy aging. Exploiting data from 29,631 users of the smartphone game, we show that, as age increases, working memory (WM) performance is compromised more by distractors presented during WM maintenance than distractors presented during encoding. However, with increasing age, the ability to exclude distraction at encoding is a better predictor of WMC in the absence of distraction. Furthermore, those who show a greater cost of distraction during maintenance showed a greater correlation between WM performance with no distraction and WM performance with distraction at encoding. A significantly greater contribution of distractor filtering at encoding represents a potential compensation for reduced WMC in older age.

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## Symposium: What the Hands Can Say About the Mind: Theoretical and Technical Insights on the Mouse Tracking Methodology

### H8, Wednesday, 16:35 – 18:15

.. 16:35 – 16:55 (293) ..

**Mousetrap: Open-source and cross-platform software for mouse-tracking data collection and analysis.** PASCAL J. KIESLICH<sup>1</sup>, FELIX HENNINGER<sup>1,2</sup>, DIRK U. WULF<sup>3,4</sup>, JONAS M. B. HASLBECK<sup>5</sup> & MICHAEL SCHULTE-MECKLENBECK<sup>4,6</sup>; <sup>1</sup>*University of Mannheim*; <sup>2</sup>*University of Koblenz-Landau*; <sup>3</sup>*University of Basel*; <sup>4</sup>*Max Planck Institute for Human Development, Berlin*; <sup>5</sup>*University of Amsterdam*; <sup>6</sup>*University of Bern*

Mouse-tracking – the analysis of mouse movements in computerized experiments – is becoming increasingly popular in the cognitive sciences. Mouse movements are taken as an indicator of commitment to or conflict between choice options during the decision process. Using mouse-tracking, researchers have gained insight into the temporal development of cognitive processes across a growing number of psychological domains. We present software that offers users easy and convenient means of recording and analyzing mouse-movements in their experiments.

First, we introduce and demonstrate the mousetrap plugin that adds mouse-tracking to OpenSesame, a popular general-purpose graphical experiment builder. It allows for the creation of mouse-tracking studies through a graphical interface, without requiring programming skills. Thus, researchers can benefit from the core features of a validated software package and the many extensions available for it (e.g., the integration with auxiliary hardware such as eye-tracking, or the support of interactive experiments).

Second, we present the mousetrap library for the statistical programming language R. This library can import mouse-tracking data from a variety of sources. It offers functions for preprocessing, analyzing, and visualizing mouse movements, and calculates a variety of established measures for curvature, complexity, velocity, and acceleration. In addition, the library offers a number of options for advanced mouse-tracking analyses, such as spatial clustering of trajectories, the identification of different trajectory types, and the animation of trajectories.

All software is cross-platform, open-source and available free of charge from <https://github.com/pascalkieslich/mousetrap-os> and <http://pascalkieslich.github.io/mousetrap/>.  
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.. 16:55 – 17:15 (294) ..

**Mouse trajectories reveal stop-and-go movements associated with cognitive processing: Evidence from a word recognition study.** SIMONE SULPIZIO<sup>1</sup>, ANTONIO CALCAGNI<sup>2</sup> & LUIGI LOMBARDI<sup>2</sup>; <sup>1</sup>*Faculty of Psychology, Vita-Salute San Raffaele University, Italy*; <sup>2</sup>*Department of Psychology and Cognitive Science, University of Trento, Italy*

In recent years, the mouse tracker (MT) methodology has been receiving increased attention in the field of cognitive psychology. Since hand movements are considered as a window into the cognitive processing, the MT methodology has been used to explore the motor components of the cognitive dynamics involved in many experimental tasks like categorization, decision-making, and language comprehension. A typical MT paradigm consists of a dichotomous choice in which the two alternatives are displayed at the top-left and top-right corner of the screen and the participant has to reach one of the two with the mouse. At the basis of the MT logic, there is often the widespread assumption that hand movement is continuous and unfolds close to the unfolding of the cognitive processing under investigation. However, the mouse, as well as the hand, movement is not continuous, and is composed of movements and stops. Thus, a method aimed to analyze only hand movements offers an imprecise and underspecified description of cognitive phenomena. To overcome these limits, we have developed a new approach to analyze mouse trajectories that takes into accounts both movement features and motor pauses. The aim of the present work is to present this method and its application to classic MT paradigms. In so doing, we re-analyzed two published datasets in order to estimate the extend to which movements and pauses are both sensitive to cognitive manipulations. Our results clearly indicate that this is the case and suggest two important conclusions: a) hand movements are not necessarily a continuous phenomenon, but can include pauses as relevant components, which indeed have to be considered in any experimental paradigm; b) cognitive factors may affect both movements features and motor pauses in a complementary way.

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.. 17:15 – 17:35 (295) ..

**Measuring the (dis-)continuous mind: A meta-analysis of hand- and mouse-tracking data.** DIRK U. WULFF<sup>1</sup> & PASCAL J. KIESLICH<sup>2</sup>; <sup>1</sup>*University of Basel, Switzerland*; <sup>2</sup>*University of Mannheim, Germany*

Mouse and hand-tracking studies often interpret curved aggregate trajectories as reflecting continuous and simultaneous competition between choice options. The assumption underlying this interpretation, i.e., that the aggregate trajectory is a proper representation of trial-level trajectories, however remains inappropriately assessed. In this project, we apply a clustering procedure to the data of 38 published articles to test the assumed homogeneity in trial-level trajectories. We find that most data sets contain, in substantial proportions, trajectory types that are inconsistent with the aggregate trajectory. Our results demonstrate that movement trajectories rarely provide a continuous window into the decision making process.

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.. 17:35 – 17:55 (296) ..

**Formation of memory traces for visual scenes: an action-dynamics approach.** MORENO I. COCO<sup>1</sup>, ANTONIO CALCAGNI<sup>2</sup>, LUIGI LOMBARDI<sup>2</sup> & NICHOLAS D. DURAN<sup>3</sup>; <sup>1</sup>*University of Edinburgh, United Kingdom*; <sup>2</sup>*University of Trento, Italy*; <sup>3</sup>*Arizona State University, USA*

A brief glimpse is sufficient to extract relevant semantic information from visual scenes. Semantic information is processed more easily when plausible and predictable. In this study, we investigate how exposure and stimulus plausibility affects the incidental formation of memory for visual scenes using an action-dynamics approach.

We asked 49 young participants to verify the content congruency of pairs of sentences and scenes, which varied in plausibility. Then, in a second phase unbeknown to them, we asked them to recognise visual scenes, which were either old or new to them. We collected responses on both verification and recognition phase using a computer mouse. On correct trials only, we utilized the EMOT method to extract different features of the two decision trajectories, as well as, to compare them. The method decomposes the trajectories in terms of fast-movements and motor pauses according to an entropic approach. Comparisons among trajectories are made in terms of entropy measures. We examined how our experimental variables of interest plausibility (plausible vs. implausible), exposure (33ms, 100ms, 250ms, 500ms), and congruency (congruent vs. incongruent) affect such features.

We found that during verification the trajectory is more complex for incongruent than for congruent

trials, especially when the visual scene was exposed for a longer time. The hesitance manifests both towards the correct and incorrect target response. When comparing the trajectories of verification and recognition, we observe larger differences when the information was implausible, the scene was presented for a longer time, and the scene was congruent with the sentence, when encoded during the verification.

Memory for visual scenes is efficiently formed even with very brief exposures and regardless of content plausibility. Moreover, confirming previous literature, the complexity underlying the arm-reaching trajectories during the two phases of the task reveals that when implausible stimuli are congruent, processing costs are observed.

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.. 17:55 – 18:15 (297) ..

**The temporal microstructure of choice task variables in the mouse tracking paradigm.** LUIGI LOMBARDI & ANTONIO CALCAGNI; *University of Trento, Italy*

Cognitive facets involved in binary choice tasks have largely been investigated based on discrete measures, such as accuracies and response times. These have been used as effective behavioral measurements to infer subcomponents of the ongoing cognitive dynamics underlying binary responses. However raters' accuracies as well as total response times are unlikely to shed light on the dynamic components of a binary choice process unfolded over time. For instance, they are unable to reveal when and where a decision has been taken by the individual before completing the choice task. In this contribution we discuss an original approach to the problem of investigating cognitive dynamics of binary choice processes. Particularly, we use the well-known mouse tracking methodology to track rating dynamics over the time. A functional representation and a computational parsing procedure are adopted to capitalize the richness of the binary choice trajectories in a set of temporal subcomponents (e.g., initiation time, verification time, and dynamic movement time) that are used to unfold the most important events occurring in a binary choice task. Finally, two real case studies from categorization tasks are illustrated to evaluate the characteristics of the new temporal measures.

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## Poster Session I Ground, Sunday, 18:30 – 21:00

.. (1001) ..

**A Look into the Future: Spontaneous anticipatory saccades reflect processes of anticipatory action control.** CHRISTINA PFEUFFER<sup>1</sup>, ANDREA KIESEL<sup>1</sup> & LYNN HUESTEGGE<sup>2</sup>; <sup>1</sup>*University of Freiburg, Germany*; <sup>2</sup>*University of Würzburg, Germany*

According to ideomotor theory, human action control employs anticipations of one's own actions' future consequences, that is, action effect anticipations, as a means of triggering actions that will produce desired outcomes (e.g., Hommel, Müsseler, Aschersleben, & Prinz, 2001). Using the response-effect compatibility paradigm (Kunde, 2001), we demonstrate that the anticipation of one's own manual actions' future consequences not only triggers appropriate (i.e., instructed) actions, but simultaneously induces spontaneous (uninstructed) anticipatory saccades to the location of future action consequences. In contrast to behavioral response-effect compatibility effects which have been linked to processes of action selection and action planning, our results suggest that these anticipatory saccades serve the function of outcome evaluation, that is, the comparison of expected/intended and observed action outcomes. Overall, our results demonstrate the informational value of additionally analyzing uninstructed behavioral components complementary to instructed responses and allow us to specify essential mechanisms of the complex interplay between the manual and oculomotor control system in goal-directed action control.

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.. (1002) ..

**Working Memory Support Facilitates the Generation of Free Choices.** CHRISTOPH NAEFGEN & MARKUS JANCZYK; *Tübingen University, Germany*

Background: Free choice tasks are tasks in which two or more equally valid response options per stimulus exist. In investigations on the putative difference between voluntary and stimulus-determined actions, free choice tasks are often used in contrast to forced choice tasks, in which only one response option is considered correct. A robust observation is that of longer response times (RTs) in free compared to forced choice tasks. The results of previous experiments from our lab suggest that the RT difference is not due to a difference in processing efficiency but to additional cognitive processes which take an amount of time independent of the stimulus presented.

Methods: The experiments presented here are part of an investigation into the nature of these pro-

cesses. Specifically, we investigated whether previously given responses influence new responses through working memory load. To this end, participants performed a free choice task, but were in some conditions provided with external memory support about their previous three or seven responses.

**Results and conclusion:** Results suggest that working memory indeed plays a role in the generation of free choice responses: In conditions without memory support, free choices were generated slower than in both the low and high memory support conditions, between which no difference was observed. Furthermore, the way any given choice was influenced by its previous choice was changed by memory support.

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.. (1003) ..

**Stairs or ramps: Gender difference in route selection.** JISIEN YANG; *National Quemoy University, Taiwan*

Numerous researches reveal that when encountering two divergent routes leading to the same destination, humans tend to apply different walking heuristics for the route selection, such as deferring the decision, initial segment strategy, adhering to the direction of destination, etc. The route selection is significantly biased in various conditions even when two routes have the same distance. In this paper, we explore another kind of route selection by examining whether people tend to take stairs or ramps when proceeding to roads with steep grades. 2,133 data were collected from the pedestrians in Zurich city (Switzerland) which has many stairs alongside the ramps to help travelers. The gender, selection (stair or ramp), and proceeding direction (climbing up or down) of the travelers were recorded. Travelers with wheel trolley suitcases or wearing high heel shoes were excluded from the records. The results shows that both males and females prefer stairs (M: 65%; F: 81%) than ramps (M: 35%; F: 19%) when climbing up the road. The Pearson chi-square test reveals significance of the crosstab. Obviously, females show a stronger tendency of taking stairs than males when climbing up the roads. However, an opposite pattern was observed when climbing down the roads. Males prefer to take ramps (55%) than stairs (45%), while females remain prefer to take stairs (70%) than ramps (30%) when climbing down the roads. Chi-square tests were significant for both males and females. The possible reasons of the gender differences in the walking route selections and its application are discussed.

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.. (1004) ..

**Free action selection without any external influence enhances the sense of agency.** ZEYNEP BARLAS<sup>1,2</sup>, WILLIAM E. HOCKLEY<sup>2</sup> & SUKHVINDER S. OBHI<sup>2,3</sup>; <sup>1</sup>*Social Cognitive Systems -CITEC- Bielefeld University, Bielefeld, Germany*; <sup>2</sup>*Center for Cognitive Neuroscience, Department of Psychology, Wilfrid Laurier University, Waterloo-ON, Canada*; <sup>3</sup>*Social Brain, Body and Action Lab, Department of Psychology, Neuroscience and Behaviour, McMaster University, Hamilton-ON, Canada*

Sense of agency (SoA) refers to the subjective experience that one has control over their actions and the outcomes of these actions. Previous research has shown that priming of actions can enhance feeling of control (FoC) judgments when these primes are compatible with the performed actions compared to when they are incompatible. The goal of the present study was to investigate the effect of supraliminal priming of actions on the SoA in both free and instructed actions. Participants were briefly presented with images of actions (i.e., lifting either index or middle finger) or a neutral image (a blank rectangle) and performed either free (neutral-free, primed-free) or instructed (prime-compatible, prime-incompatible) actions in response to a colored stimulus. All actions produced a tone after a jittered delay. We obtained estimates of action-outcome intervals, FoC ratings over the outcomes, and perceived effort ratings for action selection. Interval estimations were taken to determine the size of intentional binding, i.e., perceived temporal attraction between actions and their outcomes. We found that both intentional binding and FoC were significantly stronger in the neutral-free condition compared to all remaining modes of action selection. Perceived effort ratings increased across the neutral-free, primed-free, prime-compatible, and prime-incompatible conditions. Additionally, in the prime-incompatible condition, intentional binding and FoC ratings were negatively correlated with the effort ratings. Our results suggest that the SoA at both low and high levels is enhanced when actions are freely selected without any external influence compared to performing free or instructed actions in the presence of action relevant stimuli.

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.. (1005) ..

**Interactions between reward-based valence and action information in a cued approach-avoidance task.** VINCENT HOOFS, THOMAS CARSTEN, NICO BOEHLER & RUTH KREBS; *Ghent University, Belgium*

**Background:** Several studies manipulating valence and action report positive-approach and negative-avoidance biases, while others find no such mappings. To further illuminate the rela-



tionship between valence and action, we combined a cued monetary incentive paradigm with an approach/avoidance joystick task.

**Method:** A reward group gained money for responding correctly to targets following valence cues, while a punishment group tried to prevent losing money this way (valence vs. neutral trials were indicated by cue color). Depending on their orientation, oval-shape targets had to be ‘approached’ or ‘avoided’ by means of joystick movements. Hence, valence information (cue) was orthogonal to action information (targets). Additionally, targets were drawn in a valence-associated or neutral color, which was, however, irrelevant for valence prospect.

**Results:** Valence cues improved performance in both groups, with a larger effect for punishment cues. This facilitation was regardless of response requirements. In contrast, irrelevant valence-associated targets produced a valence-approach bias, in that they facilitated responses in approach trials and impaired in avoid trials. While being present in both groups, this bias was emphasized in the reward group.

**Discussion:** Valence cues improved performance action-independently, while valence-associated targets triggered approach behavior– even when being detrimental for performance, and even for negative valence. These findings suggest absent valence-action mappings when valence and action information are orthogonal and separated in time, which emphasizes a pro-active, instrumental approach. Moreover, irrelevant valence signals, especially positive ones, seem to facilitate approach behavior in a more automatic fashion. These results may help integrating previous opposing findings on valence and action.

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.. (1006) ..

**Response-effect anticipation does not show conceptual generalization: Evidence from the Bilingual Response-Effect Compatibility Paradigm.**

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The ideomotor principle states that actions are represented by their anticipated sensory effects. This notion can be tested using the response-effect compatibility (REC) paradigm, where participants’ are presented either with a compatible or incompatible response effect after their response (e.g., right-hand response → right-side effect is compatible, while right-hand response → left-side effect is incompatible). Reaction times are shorter in the compatible condition compared to the incompatible condition (i.e., R-E compatibility effect), suggesting that effect anticipation plays a role in ac-

tion control. This type of effect anticipation has only been investigated on a perceptual basis, even though some studies suggest that effect anticipation can have a conceptual basis as well (i.e., a compatibility effect was found when the same effect was presented in different formats). However, in the only study speaking for conceptual generalization of response effects using vocal responses and verbal effects, the possible role of phonological overlap in the compatibility effect cannot be excluded, and thus one could suspect that the effect found in these studies was not really due to the conceptual overlap between the response and effect words. The present study introduces a bilingual setting of the REC paradigm in three experiments, which exclude this possible influence of phonological overlap (i.e., in the R-E compatible condition, the effect translation equivalent of the response word, presented in a different language). Our findings confirm the assumption that response-effect compatibility effect can be obtained only when presenting the response word as effect (i.e., conceptual and phonological overlap), but the compatibility effect is not found when the semantically same word is presented in a different language (conceptual overlap only). This suggests a perceptual basis of R-E compatibility effects.

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.. (1007) ..

**The Wason Selection Task: Reasoning, Decision Making or Both?** MARIA DOLORES VALINA GARCIA & MONTERRAT MARTIN RAJO; *University of Santiago de Compostela, Spain*

The aim of this study is to present some of the more recent lines of experimental research into Wason’s selection task (Wason, 1966, 1968) and the main debates which have arisen from this. The paper concerns an experimental task which is considered essential in the study of the role of pragmatic variables in conditional reasoning (Evans, 2017).

On a theoretical level, different explanations have been considered: Theory of Pragmatic Reasoning Schemas (Cheng & Holyoak, 1985), Social Contract Theory (Cosmides, 1989), Theory of Mental Models (Johnson-Laird & Byrne, 1991) or The Dual Process Theory (Evans & Over, 1996). On an empirical level, numerous experimental studies have been designed in which the role of variables such as content, scenario, influence of prior knowledge, experimental instructions, etc. were analysed. The results of a large part of this work have highlighted the plasticity of reasoning toward factors related to empirical knowledge. Likewise, they have been the origin of new approaches in reasoning research which attempt to respond to such questions as: (1) “Why does facilitation oc-

cur largely when deontic as opposed to indicative versions are presented?"; (2) "Do the pragmatic aspects which are activated upon the presentation of deontic statements also occur with indicative statements?"; (3) "When subjects are faced with the task, do they decide which cards to select before thinking about them (Ball, Lucas, Miles & Gale, 2003; Evans, 1996; Evans & Ball, 2010; Lucas & Ball, 2005), or do they think before selecting? (Handley, Newstead & Neilens, 2009)".

In addition, research into the selection task has formed the basis for general theoretical debate, such as human rationality or the study of individual differences, and has contributed to the configuration of a new paradigm in the Psychology of Reasoning (Over, 2009; Elqayam, Bonnefon & Over, 2016).

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#### **Probabilistic Reasoning About Cards and Dices.**

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The probabilistic truth table task (PTTT) asks people to assess the probability for a conditional to be true in various contexts (e.g. Evans, Handley, & Over, 2003). It has been one of the main evidence supporting the claim that the probability for a conditional of the form if p, then q to be true is the conditional probability:  $P(p \rightarrow q) = P(q | p)$ . This constitutes a fundamental tenet of probabilistic approaches of reasoning (e.g. Oaksford & Chater, 2007). Unexpectedly, researches using PTTT also consistently revealed a substantial minority of conjunctive responders:  $P(p \rightarrow q) = P(p \wedge q)$  (e.g. Evans et al., 2003). No fully satisfactory explanation of this phenomenon has been offered to date. The objective of the present work was to study the impact of the task format on participants' answers.

We presented 96 participants with PTTT using cards (6 to 9 depending on trial) or dice's sides (always 6) in a 2 (items presented as cards vs. dice's sides)  $\times$  2 (presentation of logical cases sorted vs. mixed) between subject design. Results show that participants gave far more conditional probability answers when they reason about cards than about dices. A trend for more conditional probability responses with sorted cases also appears despite not reaching significance.

We argue that these results can be explained within the revised mental model theory framework (Barrouillet, Gauffroy, & Lecas, 2008). Cards and to a lesser extent sorted cases would elicit a complete mental representation of cases leading to more conditional probability answers. These findings suggest that PTTT is sensitive to minor changes and may not be as reliable a task as broadly admitted to study conditional reasoning.

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#### **Developmental Changes in Risk-Taking Behavior: How Important is the Known Outcome Probability?**

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Recent developmental models suppose higher risk-taking tendencies in mid-adolescence being elicited by an imbalance between an immature neural system underlying cognitive-control functions, and an early-emerging dominant system regulating socio-emotional motivated behavior. However, empirical findings in support of this view are inconsistent (see Defoe, Dubas, Figner & Aken, 2015). Not only the socio-emotional context in which risk-taking behavior takes place but also the degree of ambiguity of outcomes following decision-making may have an impact on the discrepancy in findings. Here we used a continuous age range between 9 and 18 years and applied three well-known risk-taking tasks (CUPS-, BART-, and STOPLIGHT-Task) differing in whether the risk (i.e., outcome probability) is always known (description-based) or not (experience-based). In the Cups-Task, participants win or lose money, while outcome probabilities can be inferred on each trial. In the Stoplight-Task, participants have to reach a goal in a simulated driving game as quick as possible. Participants either can decide to stop at a yellow traffic light (leading to a loss of time) or not, resulting in gaining time or losing even more time, if an accident occurs, whereas probabilities of accidents are unknown. Finally, in the Balloon-Analogue-Risk-Task (BART) participants can win money for each pump but lose all already collected money, if the balloon explodes at an unknown explosion point. In an ongoing study, we tested so far 101 participants (mean age = 12,6 years; 40% female). Results for the adjusted number of pumps in the BART and risky choices in the STOPLIGHT-Task support the view of heightened risk-tendencies in mid-adolescence by showing a quadratic age trend, while significant age differences were absent in the CUPS-Task. These findings suggest that a greater sensitivity to risk in mid-adolescence, as supposed by dual-systems models, might only be present in uncertain decision-making situations.

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#### **The evaluation of naturalistic food images in competitive versus non-competitive conditions.**

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**BACKGROUND.** Previous research demonstrates an active role of human orienting processes in evaluative decision-making and preference formation. However, little is known about how the nature of the decision influences the orienting processes during evaluation. We hypothesized that evaluation in competitive conditions might engage a different type of information processing as compared to non-competitive conditions. Particularly, in competitive conditions, evaluation might involve a relatively large dependence on memory (e.g., comparing current images to previously viewed images) and might induce an amplification of affective processing (i.e., more pronounced subjectivity) as the task effectively requires categorical decision-making, imposing a bimodal distribution with preferred versus non-preferred images.

**METHOD.** To investigate the influences from the type of decision-making task, we examined the choice processes with naturalistic food images with a competitive condition, 'Shopping', versus a non-competitive condition, 'Liking'. In the 'Liking' task, participants were instructed to answer 'How much do you like this food image?' by choosing a number from 1 ('not like at all') to 5 ('like very much'). In the 'Shopping' condition, the question was 'Would you like to add this food image to your shopping basket?' and required a 'yes' or 'no' response. Exposure time, rating score and reaction time were recorded.

**RESULTS.** A categorical mind-set was observed in the 'Shopping' condition, characterized by shorter evaluation times as compared to the 'Liking' condition. Moreover, in the 'Shopping' condition there was a more pronounced correlation between preference and exposure time than in the 'Liking' condition, with a higher likelihood of selecting an item for inclusion in the shopping basket for longer viewing times.

**DISCUSSION.** The data suggested that a competitive mind-set promotes a visually driven accumulation of commitment toward a choice, similar to the concept of gaze cascade.

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**Children's probabilistic and risk-taking reasoning is improved when using tangible vs. computer interfaces.** ZOI NIKIFORIDOU<sup>1</sup>, SARA RODRIGUEZ-CUADRADO<sup>2</sup> & CARLOS ROMERO-RIVAS<sup>2</sup>; <sup>1</sup>Liverpool Hope University, United Kingdom; <sup>2</sup>Edge Hill University, United Kingdom

Recent literature suggests that tangible interfaces enhance learning (e.g., Marshall, 2007). More specifically, tangible methods would help children to think about math problems in new ways, im-

proving their performance (e.g., Laski et al., 2015). Nevertheless, little is known about how tangible interfaces can modulate children's probabilistic and risk-taking reasoning. Therefore, the aim of the current study was to explore this issue, presenting the materials in different modalities (tangible vs. computer interface). Children (N = 480) aged 4-6 years old took part in a probabilistic game, where they had to infer the most probable outcome out of a set of cards, and in a varied form of the Cups Task (Levin et al., 2007), in which risk preferences were assessed. Importantly, in the Cups Task, some trials were framed in such a way that participants had to choose between the sure gain of one token and a designated probability of winning multiple tokens or losing all (gain frame); some other trials were framed in such a way that participants had to choose between the sure loss of one token and a designated probability of winning multiple tokens or losing all (loss frame). Results showed that in the probabilistic game, children gave significantly more accurate predictions when using the tangible interface as compared to the computer interface. In the risk-taking task, children gave more risky responses in the loss frame than in the gain frame, giving support to the Prospect theory (Kahneman & Tversky, 1979) in a younger population. Most interestingly, the difference in risk-taking choices between gain and loss frames only appeared when using the tangible interface, and not the computer interface. These results suggest that children show an appreciation of gain and loss in risky situations, and that tangible interfaces improve their performance in probabilistic and risk-taking reasoning.

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**Probing the functional role of perceptual simulation in the sentence picture verification task.** FALK HUETTIG<sup>1</sup>, MARKUS OSTAREK<sup>1</sup>, ISHAG ADIL<sup>2</sup> & JOOSEN DENNIS<sup>1</sup>; <sup>1</sup>Max Planck Institute for Psycholinguistics, Netherlands, The; <sup>2</sup>International University of Africa at Khartoum

Zwaan, Stanfield and Yaxley (2002) found that participants responded faster to pictures of objects matching rather than mismatching the implied shapes of objects mentioned in sentences. This has been widely interpreted as evidence that perceptual simulations are used for sentence comprehension. The present study was designed to probe the functional role of such hypothesized simulations by interfering with different processing stages in the visual system in three high-powered experiments (N 100 per experiment), the key idea being that interfering with a particular visual processing stage should considerably reduce the effect if it is functionally relevant for producing it. In Experiment 1, dynamic Mondrian-type masks that select-

ively interfere with basic visual processes (Yuval-Greenberg & Heeger, 2013) were flashed at the participants at 10Hz in half of the trials while they were listening to the sentences. This technique has recently been shown to interfere with the retrieval of visual information during semantic processing of spoken words (Edmiston & Lupyan, 2016; Ostarek & Huettig, 2017). We observed a reliable facilitation effect for shape matching vs. mismatching pictures (thus replicating Zwaan et al., 2002), but low-level visual noise had no impact on the match advantage. In Experiment 2, we constructed mid-level visual noise by superimposing ca. 30 pictures of random objects and deforming them until they were no longer recognizable as objects. The rationale was to achieve the complexity of holistic object processing without triggering conceptual processing. Again, we found an advantage for matching trials but no interaction with mid-level noise. Finally, in Experiment 3 the meaningless flashes of visual noise were replaced by an array of random objects to interfere with holistic object processing. This high-level noise made the match effect vanish completely. Overall, these results cast doubts on the interpretation that perceptual simulations underlie performance in the sentence picture verification task.

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**The muscle feedback from smiling makes you put many /i:/s into names for positive things.** SUSANN ULLRICH, RALF RUMMER & SCHWEPPE JUDITH; *Erfurt University, Germany*

Research in the field of phonological iconicity has revealed accumulating evidence for systematic relationships between attributes of objects and their names – contrary to the widespread linguistic assumption that this relationship be arbitrary. A big criticism, however, is that those studies mostly employ pseudo-names that could be biased in their selection. In the group of Prof. Rummer, a new active naming paradigm is being used to prevent such potential bias. A series of active naming studies for faces or objects showed that people consistently choose names containing the vowel /i:/ preferably for positive objects, and names with /o:/ for negative objects. The articulatory feedback hypothesis (Rummer et al., 2014), which suggests that strong neural associations between muscle movements during facial emotion display (in particular the smile/i-face and the antagonistic o-face) and articulation are responsible for these effects, offers a plausible explanation for those phenomena. However, those first explorative studies had not controlled for other potentially influential object attributes such as arousal, brightness, size or shape. Also the number of /i:/s and /o:/s in the German

names of the shown objects could have confounded the results. Hence, in the most recent study, we gathered ratings of the dimensions of these object attributes and used them together with the vowel occurrences as extensive controls. 45 object pictures were chosen for each valence category (positive, negative, neutral) and 218 subjects produced new names for those objects. Again, /i:/s were preferably used in new names for objects with positive valence, and /o:/s in names for objects with negative valence. For the other vowels no significant valence effects were found. This strengthens the idea that this surprisingly robust vowel-valence link specifically found for vowels corresponding to the i- and o-face is based on the articulatory feedback hypothesis.

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**A behavioral study of somatotopic semantic priming.** VALERIE KELLER<sup>1,2</sup>, LUIGI GRISONI<sup>1</sup>, PIA KNOEFERLE<sup>2,3</sup> & FRIEDEMANN PULVERMÜLLER<sup>1,3,4</sup>; <sup>1</sup>*Brain Language Laboratory, Department of Philosophy and Humanities, Freie Universität Berlin, Germany;* <sup>2</sup>*Humboldt Universität zu Berlin, Department of German Studies and Linguistics, Germany;* <sup>3</sup>*Berlin School of Mind and Brain, Humboldt Universität zu Berlin, Germany;* <sup>4</sup>*Einstein Center for Neurosciences, Berlin, Germany*

The recognition of action-related sounds and words activates motor regions, reflecting the semantic grounding of these symbols in action information; in addition, motor cortex exerts causal influences on sound perception and language comprehension. However, proponents of classic symbolic theories still dispute the role of modality-preferential systems such as the motor cortex in the semantic processing of meaningful stimuli. To clarify whether the motor system carries semantic processes, Grisoni et al. (Cerebral Cortex, 2016) investigated neurophysiological indexes of semantic relationships between action-related sounds and words. As their results showed neurophysiological manifestations of action-semantic priming in the motor cortex, they suggested that semantic processing is carried, at least in part, by the motor cortex of the human brain.

The problem with this conclusion is that semantic priming is a behavioral phenomenon. As Grisoni et al. did not collect behavioral responses, but presented meaningful stimuli in a passive paradigm, it remains unclear whether their neurophysiological activity reductions do indeed correspond to a true behavioral priming effect. Therefore, we carried out a cross-modal priming study. After being primed with sounds of either hand- or face-related actions (e.g., finger/tongue clicks), participants had to perform a semantic decision

task on visually presented action words (i.e., “digging”/“singing”). We found that words presented after body-part-congruent prime sounds (finger click – “digging”) were processed more rapidly than the same words shown in body-part-incongruent contexts. Analyses of distributional properties of word and sound stimuli ruled out an explaining of this priming effect in terms of their co-occurrence across texts. We conclude that the semantic relationship between sounds and words immanent to their similar indexical or referential body-part-relationship is manifest in semantic priming. Together with the neurophysiological results by Grisoni et al., our results bolster the role of modality-specific motor systems and motor information in semantic priming and processing.

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**Effects of transcutaneous Vagus Nerve Stimulation (tVNS) on implicit and explicit religiousness and spirituality.** ALESSANDRA FINISGUERRA<sup>1</sup>, COSIMO URGES<sup>2</sup>, SIMONE PETERLINI<sup>3</sup>, CRISTIANO CRESCENTINI<sup>2</sup> & LORENZA S. COLZATO<sup>1</sup>; <sup>1</sup>Leiden University, Netherlands, The; <sup>2</sup>Udine University, Italy; <sup>3</sup>Padova University, Italy

Religiousness and spirituality are basic elements featuring human life. However, only in recent years the interest in the neural underpinning underlying these experiences has grown. Previous evidence showed that the vagal tone (as indexed by heart rate variability) is influenced by activation of religious and spiritual self-representations. So far, in healthy humans it has not yet been demonstrated whether directly interfering with vagal tone alters religiousness and spirituality. To explore this we used transcutaneous vagus nerve stimulation (tVNS), a novel non-invasive brain stimulation technique that causes the vagus nerve to fire via the application of a mild electrical stimulation to the auricular branch of the vagus nerve. A sham/placebo-controlled, randomized cross-over within-subject design was employed to infer a causal relation between the stimulated vagus nerve and implicit and explicit religiousness and spirituality by means of i) Religious, ii) Spiritual and iii) control Self-esteem Implicit Association Tests, as implicit measures of self-representations. Moreover, we tested the effect of tVNS on religious and spiritual-explicit representations, as measured through i) the Index of Core Spiritual Experiences questionnaire and ii) the Self-Transcendence scale of the Temperament and Character Inventory. Preliminary results showed that active tVNS, compared to sham stimulation, affected implicit spiritual self-representation, by reducing the strength of the automatic association between the self and the spiritual dimension, but leaving explicit representa-

tions unchanged. Our findings corroborate the idea that the autonomic nervous system controlling vagal tone seems to be causally involved in implicit spirituality.

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**When visual objects evoke multiple gestures: Impact of conflict between affordances on Mu rhythm desynchronization.** YANNICK WAMAIN, SAHAI AISHA, DECROIX JEREMY, COELLO YANN & KALENINE SOLENE; CNRS, University of Lille, France

Whereas several recent studies have evidenced a competition between distinct gesture representations during planning and execution of object-directed actions, very little work has focused on the existence of such a competition during mere object observation. Nevertheless, a similar conflict seems to be at play during manipulable object perception, which slows down object visual processing. The aim of the present EEG study was to investigate the neurophysiological correlates of conflict between gesture representations during object perception. The impact of the conflict between evoked gestures on the activation of the motor neural network was specifically tested. Fifteen participants performed a reach-to-grasp and a semantic judgment task on conflictual (with competing structural and functional gestures) and non-conflictual (with similar structural and functional gestures) objects. Objects were presented at difference distances in a 3D virtual environment while EEG was recorded. Time-frequency decomposition was used to compute the power change induced by object presentation on the 8-12 Hz frequency band recorded in the parieto-central region ( $\mu$  rhythm) known to reflect the activation of the sensorimotor neural network. Results revealed that  $\mu$  rhythm desynchronization was reduced when the observed object evoked distinct gesture representations. More specifically, reduction of  $\mu$  desynchronization for conflictual objects was selectively observed when objects were presented in peripersonal space, where both structural and functional gestures are potentially relevant. However, the effect was independent from the task performed by the participants. Findings demonstrate that conflict between evoked gesture representations reduces the involvement of motor neural network during visual perception of objects in peripersonal space.

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**Perception of expressive body movements by individuals with autism spectrum disorder.** VASSILIS SEVDALIS<sup>1,2</sup>, JENNIFER MAYER<sup>3,4</sup>,

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Individuals with autism present impairments in social interaction and communication. Little is known about how music and dance are processed by these individuals, especially regarding the expressive and perceptual properties of such signals. The present study investigated the perception of biological motion by individuals with Autism Spectrum Disorder (ASD) in point-light displays depicting dance. Adult participants with ASD and a matched typically developing control group watched point-light displays (1-5 seconds long) depicting expressive and inexpressive dance movements in visual-only, audiovisual-congruent (i.e., synchronous music to movement) and audiovisual incongruent (i.e., asynchronous music to movement) conditions. The task was to identify the dancer's intended expression intensity (i.e., expressive vs. inexpressive). A signal detection analysis indicated that expressive body movements were identified reliably even for displays of 1s, and equally well in both ASD and control groups, with discrimination accuracy improving with increasing stimulus duration. Accuracy did not differ across visual-only, audiovisual congruent, and audiovisual incongruent conditions. Although individuals with ASD scored significantly lower than controls on self-report empathy and alexithymia scales, no relation between these measures and perceptual discrimination accuracy was found. The results are discussed in relation to the potential of music and dance signals to stimulate the latent communicative skills of ASD individuals.

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**Masked semantic priming with bilingual children and adults.** ARIS TERZOPOULOS<sup>1,2</sup>, LYNNE DUNCAN<sup>1</sup>, GEORGIA NIOLAKI<sup>2</sup> & JACKIE MASTERTSON<sup>3</sup>; <sup>1</sup>University of Dundee, United Kingdom; <sup>2</sup>Coventry University, United Kingdom; <sup>3</sup>University College London

Two experiments investigated priming effects of cognate and non-cognate translations in two different languages Greek and English. Experiments 1 and 2 involved adults and children, respectively, with either Greek or English as their dominant language who participated in a masked priming semantic categorisation task. The experimental stimuli were cognate and non-cognate translations or unrelated pairs where either the prime was in the dominant language (L1) and the target in the non-

dominant (L2) or vice versa. In Experiment 1, priming for cognate translation exemplars was observed relative to the control baselines only in the L1-L2 direction (priming asymmetry). There were no effects for non-cognates. In Experiment 2 the task was the same but participants were 10 to 11-year-old bilingual children, with Greek or English as their dominant language. Priming effects were observed for cognate translations in the L2 - L1 direction, whereas non-cognates did not show any effects. The results for adults are in congruence with previous research with unbalanced bilinguals and are discussed within current models of bilingual semantic organisation. The results from the children experiment are discussed with reference to task demand characteristics and effects of new methods of teaching L2 to early learners which allow exploitation of their concepts. The importance of selecting stimuli from bilingual word databases (in the current study the newly constructed Greek-English bilingual database BiLex-Kids was used) is also discussed.

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**Decision making in a not-so-foreign language: is there a reduction of decision biases in Venetian dialect?** ENRICA MELLO<sup>1</sup>, MICHELE MIOZZO<sup>2</sup> & FRANCESCA PERESSOTTI<sup>1</sup>; <sup>1</sup>University of Padova, Italy; <sup>2</sup>New York University, US

Venetian dialect is largely used in Veneto region (Italy). It is primarily spoken at home or in other highly familiar contexts, learned early in infancy, not used at school or other formal contexts. In the present study we investigated the influence of the use of dialect in decision making. It has been shown that the use of a second late-learned language (L2) modulates decision making, reducing decision biases in different types of problems (e.g. Keysar et al. 2012; Costa et al., 2014). This foreign language effect has been explained by assuming that the use of L2 is associated with a reduced emotional involvement in decision making, allowing more rational choices. This assumption cannot be extended to the case of dialect, which is considered a highly emotional language. As a consequence a different decisional pattern for L2 and dialect should be predicted. Contrary to this expectation, we obtained the same bias reduction for L2 and Venetian dialect, both in the Asian Disease and in the Discount problem. We also showed that the reasoning at the basis of the choices performed using Venetian dialect in the Discount problem is not rational. Overall the results question the conclusion that the reduction of decisional biases in L2 is uniquely due to a reduction in the emotional involvement.

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**Predictability in L1 and L2 natural reading.**  
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Predictability of the upcoming word while reading a sentence is assumed to be an important factor in lexical processing. In monolingual reading, it has for example been found that the processing of predictable words is facilitated: they receive shorter fixations or are skipped more often (e.g., Kliegl et al., 2004). It is however an important question whether these effects are similar in second language processing. It could for example be that L2 readers rely on top-down information to a greater extent, as their bottom-up processing is impaired for their less developed language, resulting in a larger predictability effect.

To address this matter, we analyzed the data of participants reading a novel in English, either as their L1 or L2. We investigated various eye movement measures (both timed and probabilistic) of the GECO database (Cop et al., 2016). Instead of classic cloze ratings, we applied a computational approach. Predictability was operationalized as a combination of two components: entropy and surprisal (e.g., Willems et al., 2016). For each of these components, a 5-gram corpus-based value was calculated. This allowed us to have predictability estimates for each of the 54 364 English words in GECO.

In the timed measures (both early and late) we found that there was an overall facilitation (shorter fixations) of more predictable words. The predictability components sometimes interacted differently with other predictors (such as word frequency) between the L1 and L2 reading times, but overall this did not result in a larger predictability effect for L2 compared to L1. In the skips and regressions however, some evidence was found that the predictability effect was larger for L2 reading compared to L1 reading.

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**Language modality shapes the dynamics of lexical access: Word and sign recognition in bimodal bilinguals.** SAÚL VILLAMERIEL<sup>1,2</sup>, PATRICIA DIAS<sup>1,2</sup>, MARCEL GIEZEN<sup>1</sup>, BRENDAN COSTELLO<sup>1</sup> & MANUEL CARREIRAS<sup>1,3,4</sup>; <sup>1</sup>*Basque Center on Cognition, Brain and Language (BCBL), Spain*; <sup>2</sup>*Master and Doctoral School of the University of the Basque Country, Spain*; <sup>3</sup>*Ikerbasque, Basque Foundation for Science, Spain*; <sup>4</sup>*Department of Basque Language and Communication, University of the Basque Country UPV/EHU, Spain*

The goal of the current study is to investigate the role of sub-lexical units in lexical access in spoken Spanish and in Spanish Sign Language (LSE) in early and late bimodal bilinguals using the visual world paradigm. Spoken words and signs both consist of structured sub-lexical units. However, while spoken phonemes unfold in time in the case of the spoken signal, visual sub-lexical units such as location and handshape are produced simultaneously in signs. Experiment 1 investigated phonological competition in Spanish from words sharing onset or rhyme. Experiment 2 investigated competition in LSE from signs sharing handshape or location.

In early bilinguals, the results confirm previous findings for word recognition: onset competition comes first and is more salient than rhyme competition. In contrast, for sign recognition the competition from handshape and location appears simultaneously, although handshape competition persists for a longer time than location competition.

Bimodal bilinguals who learned LSE as a second language later in life showed the same pattern as early bilinguals for word recognition. In sign recognition, handshape and location competition appear simultaneously, but location competition persists for a longer time than handshape competition, the reverse pattern as observed in early signers.

These findings demonstrate that modality-specific aspects of sub-lexical organization impact the dynamics of lexical access in spoken and signed languages: sequentiality predominates in the spoken modality whereas sign languages favour simultaneity. Furthermore, the results suggest that age of acquisition affects the relative importance of sub-lexical units in lexical access. Specifically, handshape appears to hold greater weight for native signers whereas late learners depend more on location during sign recognition, which might be a perceptually more salient sub-lexical unit.

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**The effects of different text presentation media and font types on adults' reading comprehension.** ELIZABETH NEWTON, JAMES SMITH-SPARK

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Readers differ in the extent to which they understand the text that they read. A range of internal, cognitive, predictors have been identified to explain individual and group differences in levels of reading comprehension. However, the role of external factors in influencing comprehension has not been explored to any great degree. The research reported in this paper sought to explore the influence of two such external factors, font type and the medium in which text was presented, on reading comprehension scores on a very well established test of reading. Ten undergraduate university students were presented with parallel versions of text from the reading text and asked to respond to questions about the passages immediately after reading them. The participants responded to passages presented in three different font types (Arial, OpenDyslexic, and Times New Roman) across three different types of media (paper, desktop PC, and tablet computer). The complexity of the text passages was matched across media and font type. There was a significant effect of reading medium on comprehension score, with text presented on a computer resulting in higher comprehension scores than when text was displayed on a tablet. There was no main effect of font type on comprehension score but a significant reading medium x font type interaction indicated that the participants showed lower levels of comprehension when text was presented on a tablet computer in Times New Roman font. The findings indicate the importance of selecting the most appropriate presentation medium and font type to facilitate reading comprehension. The results are particularly relevant where text is read for work and study, especially for individuals or groups who find understanding more difficult.

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**The neurophysiological signature for reading comprehension in deaf adults.** PATRICIA DIAS<sup>1,2</sup>, SAÚL VILLAMERIEL<sup>1,2</sup>, SENDY CAFARRA<sup>1</sup>, BRENDAN COSTELLO<sup>1</sup> & MANUEL CARREIRAS<sup>1,3,4</sup>; <sup>1</sup>*Basque Center on Cognition, Brain and Language, Spain*; <sup>2</sup>*Master and Doctoral School of the University of the Basque Country, Spain*; <sup>3</sup>*Ikerbasque, Basque Foundation for Science, Spain*; <sup>4</sup>*Department of Basque Language and Communication, University of the Basque Country UPV/EHU, Spain*

The main goal of the present study is to investigate the brain mechanisms that underlie reading comprehension in skilled deaf readers. To understand how deaf readers process syntactic and semantic information, we used EEG to record brain activity from two different groups of deaf (N=20) and hearing (N=25) adults during a sentence com-



prehension task. Within a grammatical violation paradigm, participants read sentences in Spanish with and without semantic or morphosyntactic errors, consisting of agreement violations for number and gender, which could be transparent (i.e. the grammatical gender is apparent from the word form) or opaque.

Results showed that deaf readers present similar brain activity compared with the hearing group to process sentences with semantic violations, reflected by a classic N400 effect. However, differences were found between deaf and hearing readers for sentences with some types of syntactic errors: while violations of agreement for number and transparent gender showed a typical P600 effect for both deaf and hearing readers, violations of opaque gender did not elicit a clear P600 effect for deaf readers.

This study demonstrates that when deaf people read sentences, the processing of morphosyntactic relations is distinct. We discuss several possibilities that could account for these differences, such as (a) the extent to which deaf readers are behaving as second language readers; (b) the role a first language (e.g. Spanish Sign Language) can play in the acquisition of a second language; (c) the importance of (semantic) context rather than morphosyntactic features in reading.

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.. (1024) ..

**Lexical processing of Croatian dyslexic children: an eyetracking study.** MARION COUMEL<sup>1</sup>, ANA MATIC<sup>2</sup> & MARIJAN PALMOVIC<sup>2</sup>; <sup>1</sup>*Cognitive Science Research Platform, University of Vienna, Austria*; <sup>2</sup>*Laboratory for Psycholinguistic Research, Department of Speech and Language Pathology, University of Zagreb, Croatia*

This pilot study aimed at determining the relative influence of phonological and semantic knowledge on lexical processing of Croatian dyslexic children in terms of their eye movement patterns. For this purpose, we adapted the Reicher-Wheeler task (Wheeler, 1970) to children with dyslexia and manipulated the frequency of letter combinations in words, pseudowords and nonwords.

Seven children with dyslexia and six control subjects were first exposed to an item from one of the three conditions and were subsequently asked to select, out of two presented letters, the one that had been seen in a specific position in the previously shown item. Accuracy, reaction time and dwell time were recorded and analyzed.

The preliminary results suggest that control participants perform better than children with dyslexia on the three conditions, which is reflected in accuracy (for words and nonwords) and dwell time (for words, pseudowords and nonwords). So far, in

spite of these differences, it seems that both groups of children rely more on phonology (i.e., they perform better on words and pseudowords than on nonwords), although this pattern is less clear in the group of children with dyslexia. Further investigation on this matter should include more participants for these preliminary results to be confirmed.

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.. (1025) ..

**Is statistical learning related to reading ability, and if so, why?** XENIA SCHMALZ<sup>1,2</sup>, KRISTINA MOLL<sup>1</sup>, CLAUDIO MULATTI<sup>2</sup> & GERD SCHULTE-KÖRNE<sup>1</sup>; <sup>1</sup>*Ludwig-Maximilians-Universität München*; <sup>2</sup>*Università degli Studi di Padova, Italy*

Previous studies have found a relationship between the performance on statistical learning (SL) tasks and reading ability (Arciuli & Simpson, 2012) and developmental dyslexia (e.g., Vicari et al., 2003). These findings suggest that the ability to implicitly derive patterns from a quasi-regular system may be important for the acquisition of reading skills. To date, however, it is unclear what causal mechanisms underlie this relationship: while it has been suggested that sensitivity to bigrams may emerge through SL and facilitate reading acquisition, there is no empirical support for this link. Furthermore, recent studies have raised concerns about the reliability of SL tasks (Siegelman & Frost, 2015) and about publication bias in the literature on SL and dyslexia (Schmalz, Altoè, & Mulatti, 2016). In the current study, we aim to address the above issues. In a large-scale study, we test 100 adult readers on two SL tasks, as well as their reading ability and their sensitivity to bigram legality. The use of two SL tasks allows us to treat SL as a latent construct, thus addressing the issue of low reliability. By measuring sensitivity to bigram legality, we can assess whether it mediates any relationship between SL and reading ability. Thus, we aim to replicate previous work which showed a relationship between SL and reading ability, and to extend the literature by assessing the viability of a potential cognitive mechanisms that drives the relationship.

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.. (1026) ..

**A resource model of phonological working memory.** CHRISTOPHER RICHARDSON HEPNER<sup>1</sup> & NAZBANOU NOZARI<sup>1,2</sup>; <sup>1</sup>*Department of Neurology, Johns Hopkins University, Baltimore, MD, USA*; <sup>2</sup>*Department of Cognitive Science, Johns Hopkins University, Baltimore, MD, USA*

Classic models of working memory (WM) place an upper bound on the number of items that can be

retained at a given time. These models predict perfect recall precision up to capacity and a sharp drop in precision past the capacity limit. Recently, an alternative “resource” model has been proposed for visual WM, which views WM as a resource divided between any number of representations to be held in memory. Recall precision thus decreases monotonically as the number of items increases. A prominent advantage of the resource model is its biological plausibility: Activity in a neural population encoding a certain item is divided by the sum of the activities of neurons in all populations encoding items, thus the larger the number of items, the lower the activity (gain) of the population encoding each item. A second advantage of the resource model is that it posits a direct link between attention and working memory, by proposing that division of resources between items is driven by attention, such that attended items receive more resources at the cost of the unattended.

In two experiments, we tested the predictions of the resource model for phonological WM when participants rated syllables on a continuum (1-100) between phoneme pairs (e.g., most /kA/ like to most /gA/ like) that differed in a single feature. Experiment 1 manipulated the set size (1, 2, 4), while Experiment 2 manipulated attention by cueing items that had a higher likelihood of being probed. Precision was measured as the reciprocal of the variance around the median rating for each stimulus.

As predicted by the resource model, precision decreased monotonically as set size increased, even from 1 to 2, and for uncued items in favor of cued. Collectively, these results support a flexible resource model of phonological WM, similar to visual WM.

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.. (1027) ..

**Parallel syntactic processing: The sentence superiority effect.** JOSHUA SNELL & JONATHAN GRAINGER; *Aix-Marseille University, Netherlands, The*

A sentence superiority effect was investigated using post-cued word-in-sequence identification with the rapid parallel visual presentation (RPVP) of four horizontally aligned words. The four words were presented for 200 ms followed by a post-mask and cue for partial report. They could form a grammatically correct sentence or were formed of the same words in a scrambled agrammatical sequence. Word identification was higher in the syntactically correct sequences, and crucially, this sentence superiority effect did not vary as a function of the target's position in the sequence. Cloze probability measures yielded low values that did not interact with the effects of sentence context, suggesting that

these effects were not driven by word predictability following partial recognition. The results thus point to a level of parallel processing across multiple words that enables rapid extraction of their syntactic categories. These generate a sentence-level representation that constrains the recognition process for its constituent word parts, thus facilitating parallel word processing when the sentence is grammatically sound.

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.. (1028) ..

**Reading without spaces revisited: The role of sentence-level constraints.** JONATHAN MIRAULT, JOSHUA SNELL & JONATHAN GRAINGER; *CNRS & AMU, France*

Prior research has shown that skilled readers can read text that is printed without extra spacing between words, albeit more slowly and less accurately than normally spaced text. Here we examined the role of top-down sentence-level constraints in facilitating the reading of unspaced text. We compared reading of grammatically correct neutral sentences and shuffled versions of the same words presented both with normal spacing and without spaces. We found an interaction between word order and spacing in eye movement measures that reflect overall reading difficulty (total viewing time per word, total reading time per sentence). There was an increased deleterious impact of removing inter-word spaces when reading shuffled text compared with intact sentences. This interaction was not found in measures that reflect the decision where to move the eyes (word skipping and regression rates, initial landing position). Furthermore, we found that the length of the currently fixated word determined the amplitude of forward saccades leaving that word during the reading of unspaced text independently of grammatical structure, thus highlighting the role of word identification processes in guiding eye movements in this condition. We conclude that the relative ease with which skilled readers can read unspaced text is due to a combination of bottom-up word recognition and top-down sentence-level constraints, with the latter factor only influencing comprehension processes and not impacting on oculomotor control.

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.. (1029) ..

**Developmental phonological dyslexia: A multiple case study of the efficacy of an audio-visual grapho-syllabic training.** BLANDINE HUBERT, JEAN ECALLE & ANNIE MAGNAN; *University of Lyon 2, Laboratoire d'étude des mécanismes cognitifs, Labex Cortex*

This study investigates the efficacy of a

computer-assisted learning as a potential treatment for phonological dyslexia. This communication will report the effect of a 10-hour computer-assisted learning program on the reading skills involving dyslexic children enrolled in a specialized school. Each child received four 30-minutes individual training sessions per week. Recent studies using different paradigms have shown that dyslexic although they have phonological impairments, they are able to use phonological processing, and especially phonological grapho-syllabic processing, which are influenced by the syllable frequency (Maionchi-Pino et al, 2010; 2012a,b). These findings have provided arguments to design computer-assisted learning that focus on syllable-based segmentation in French children to improve reading ability. Thus, in the ChassymoDys software, the words and syllables are presented in both visual and auditory terms. First, children must do discriminate oral words on the basis of the first syllable presented. Then, the presentation of the written word will help to strengthen the letter-sound correspondences necessary for the decoding procedure, here based on the grapho-syllabic processing. After hearing and seeing a syllable and then having heard two words successively (separated by 500 ms), the children must do click on the circle corresponding to the word heard which contains the target syllable. This intervention was aimed to strengthen the grapho-syllabic processing and the phonemic discrimination abilities. The reading and phonological skills were assessed twice prior to undertaking the training (baseline) and at the end of training. For each participant we compare the performance gap between T2 and T1 (training) and between T1 and T0 (baseline). The effectiveness of audio-visual grapho-syllabic training by integrating a task of discrimination of phonemes will be discussed to support the hypothesis that dyslexics' deficits do not depend on degraded or underspecified phonological representations, but stem from impaired access to phonological representations (Ramus & Szenkovits, 2008).

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.. (1030) ..

**Russian Sentence Corpus.** ANNA LAURINAVICHYUTE<sup>1</sup>, SVETLANA ALEXEEVA<sup>2</sup>, IRINA SEKERINA<sup>3</sup> & KRISTINE BAGDASARYAN<sup>4</sup>; <sup>1</sup>University of Potsdam, Germany; <sup>2</sup>St.-Petersburg State University; <sup>3</sup>City University of New York; <sup>4</sup>National Research University Higher School of Economics

We present a corpus of eye-tracking data from 96 individuals reading 144 Russian sentences, analogous in design and structure to the Potsdam Sentence Corpus (Kliegl et al., 2004). Each sentence in the corpus contains a target word, whose properties are orthogonally manipulated between part of

speech (noun, verb, adjective), frequency (<10 or >50 ipm), and length (3-4, 5-7 or 8-10 letters). The target words were randomly picked from a database based on the required properties, then sentences containing these words were picked from the Russian National Corpus. After conducting acceptability norming (N=215), we collected predictability ratings (N=750) for each word in every sentence.

Participants were tested on the EyeLink desktop mount at the sampling rate of 1000 Hz. 9-point calibration was repeated after every 15 sentences. For 1/3 of the trials, the sentence was followed by a comprehension question.

For the target words, our results closely replicate the Potsdam Sentence Corpus data. The most notable difference between the two corpora is the influence of the square of word's length (which exaggerates the difference between short and long words): in German, increase in the length<sup>2</sup> leads to an increase in FFD, SFD, GD, and TT, while in Russian it leads to a decrease in FFD and SFD. We hypothesize that it has to do with inflectional morphology of Russian: longer words contain more inflectional morphemes that can be anticipated in the context, and readers take advantage of such anticipatory information by spending less time on longer words with inflectional morphemes.

We also found that the part of speech property affects GD and TT: nouns were read faster than verbs. It is a well-known fact that verbs require more processing than nouns in production and comprehension, but to our knowledge we are the first to demonstrate that verbs are read slower.

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.. (1031) ..

**Contextual diversity facilitates learning new words in the classroom.** EVA ROSA<sup>1</sup>, JOSÉ LUIS TAPIA<sup>1</sup> & MANUEL PEREA<sup>2</sup>; <sup>1</sup>Catholic University of Valencia, Spain; <sup>2</sup>University of Valencia

In the field of word recognition and reading, it is commonly assumed that frequently repeated words create more accessible memory traces than infrequently repeated words, thus capturing the word-frequency effect. Nevertheless, recent research has shown that a seemingly related factor, contextual diversity (defined as the number of different contexts [e.g., films] in which a word appears), is a better predictor than word-frequency in word recognition and sentence reading experiments. Recent research has shown that contextual diversity plays an important role when learning new words in a laboratory setting with adult readers. In the current experiment, we directly manipulated contextual diversity in a very ecological scenario: at school, when Grade 3 children were learning words in the classroom. The new words appeared in different contexts/topics (high-contextual diversity) or only

in one of them (low-contextual diversity). Results showed that words encountered in different contexts were learned and remembered more effectively than those presented in redundant contexts. We discuss the practical (educational [e.g., curriculum design]) and theoretical (models of word recognition) implications of these findings.

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.. (1032) ..

**Handwriting and typing: Impact on bursts of written language.** SIRINE BOURIGA & THIERRY OLIVE; *Centre de Recherche sur la Cognition et l'Apprentissage, France*

Writing with a computer makes writing more fragmented. Writers focus on local aspects of their text at the expense of a global processing. Indeed, composing a text with a computer increases cognitive effort, reduces frequency of planning and reviewing (Kellogg & Mueller, 1993), increases pause time (Van Waes & Schellens, 2003), and writers revise more the surface aspects of their text (Daiute, 1986). Whether computer writing affects text quality is still in debate. To further understand how using a computer affects writing, we investigated writers' pauses, and execution periods, i.e., periods of text transcription between two consecutive pauses (Kaufer et al., 1986). If writing is more fragmented with computers, then, we expect a more pauses and execution periods, with shorter execution periods. We also analysed text characteristics such as orthographic errors and syntactic complexity. Thirty-four students from the University of Poitiers participated in the experiment. Each participant wrote two argumentative texts, one handwritten and the other typewritten. Both conditions were counterbalanced. A list of 6 themes was proposed to participants who composed about a different topic in each mode of writing. To analyse pauses and execution periods, we used an individual threshold based on pauses above the third quartile of the pause distribution. Participants who wrote their text on the computer spent 69% more time on pause, and produced twice as more numerous execution periods, which were also almost 3 times shorter. In addition, the texts composed with a computer were longer and contained more spelling errors. Syntactic complexity was not affected by the writing tool. In conclusion, this study confirms that writing a text on a computer, on the one hand, leads to more fragmented and less fluid writing in terms of writing processes and, on the other hand, negatively affects text quality.

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.. (1033) ..

**Functional changes in children with mixed or isolated deficits in reading or spelling.** CHIARA BANFI<sup>1</sup>, KARL KOSCHUTNIG<sup>1</sup>, MELANIE GANGL<sup>1</sup>, FERENC KEMENY<sup>1</sup>, ANDREAS FINK<sup>1</sup>, KRISTINA MOLL<sup>2</sup> & KARIN LANDERL<sup>1</sup>; <sup>1</sup>*University of Graz, Austria*; <sup>2</sup>*Department of Child and Adolescent Psychiatry, Psychosomatics and Psychotherapy, LMU Munich*

The present functional magnetic resonance imaging (fMRI study) investigated orthographic processing selectively related to reading or spelling difficulties. Previous behavioral findings suggested that children with isolated spelling difficulties may over-rely on sublexical reading strategies as a compensatory mechanisms for a poor orthographic lexicon. However, fMRI studies focused mainly on developmental dyslexia, often taken as a condition where both reading and spelling skills are below expectations. Only a few studies reported on neuro-functional alterations specifically associated to reading vs. spelling difficulties, using writing or indirect reading paradigms. We investigated whether children with mixed reading and spelling problems or isolated spelling difficulties share the same neuro-functional substrates of alteration when reading aloud words and matched pseudohomophones. Participants were 3rd graders from elementary schools in Graz (Austria). Three groups were recruited based on standardized reading and spelling tests: reading and spelling deficits (RSD; N=23), spelling deficit only (SD; N=21) and typical development (N=27). In the contrast of interest, i.e. words vs. pseudohomophones, the RSD group showed reduced activation in the left inferior temporal area and increased activation in two left frontal areas. Interestingly, the SD group showed no regions of reduced activation in comparison to controls, but had increased activity in the right supplementary motor area and precuneus. Compared to the RSD group, the SD group showed increased activity for words in a left temporo-parietal region. The present findings highlight the existence of different functional substrates of alteration underlying the combined profile with reading and spelling difficulties compared to isolated spelling impairments. Importantly, the SD group, despite their age-adequate reading performance, showed higher activation than the RSD group on a left dorsal region related to phonological processing, thus suggesting a stronger reliance on sublexical strategies in the SD group when reading words.

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.. (1034) ..

**Neural Correlates of Lexical and Non-lexical Word Processing in Reading and Spelling Deficit.** FERENC KEMÉNY<sup>1</sup>, MELANIE GANGL<sup>1</sup>, CHIARA BANFI<sup>1</sup>, CORINNA PERCHTOLD<sup>1</sup>, ILONA PAPOUSEK<sup>1</sup>, KRISTINA MOLL<sup>2</sup> & KARIN LANDERL<sup>1</sup>; <sup>1</sup>University of Graz, Graz, Austria; <sup>2</sup>Department of Child and Adolescent Psychiatry and Psychotherapy, University Hospital Munich, Munich, Germany

Children with Developmental Dyslexia show a deficit in word reading. This deficit is not only transparent in the behavioural domain, but also the neural correlates of word reading seem to be affected. Previous studies have also shown that while in most cases, both reading and spelling are affected in Developmental Dyslexia, however, the two domains can be selectively impaired.

The aim of the current study is to disentangle whether the previously observed word reading deficits are due to deficient reading or spelling skills. In accordance, we tested three groups of 9-year-old children: one with combined reading and spelling deficit, one with isolated spelling deficit (ISD), and a control group of typical readers. The children participated in an EEG experiment in which they had to read or observe words, pseudowords and sequences of letter-like stimuli (false fonts). Three components were analysed: a temporo-occipital N170, a temporo-occipital P300 and a central N400.

Results showed that participants of the combined group treat letters like false fonts in the early time-window. This input deficit disappeared by 300 msec. The amplitude modulations of the N170 and P300 components were comparable between the ISD and control groups. The central N400 component, however, only showed a significant lexical effect (comparison of words versus pseudowords) in the case of the control group, not the clinical groups. The results argue that the combined group shows an input deficit, as well as deficient access to the elements stored in the lexicon, while ISD children show a lexical deficit.

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.. (1035) ..

**Information about the talker's voice can affect word meaning.** EFTHYMIA C. KAPNOULA<sup>1</sup> & ARTHUR G. SAMUEL<sup>1,2</sup>; <sup>1</sup>Basque Center on Cognition Brain and Language; <sup>2</sup>Stony Brook University

Previous work has shown that indexical information (a talker's gender, affective state etc.) and seemingly odder sources of information (e.g. a dog barking during a word) can affect spoken word recognition (Goldinger, 1998; McLennan & Luce, 2005; Pufahl & Samuel, 2014; Vitevitch & Donoso, 2011). However, such variability is thought to have no consequences for determining a word's referent.

It is an open question whether the absence of indexical effects on referent selection is a result of learning or whether it is due to internal constraints of the system.

We addressed this issue using a word learning paradigm designed to support the use of voice information in referent selection. Participants learned eight novel words (e.g. bifa) and their meanings. Each word was presented in one of three different voices and referents were familiar objects (e.g. tables, kites). Half of the words were assigned to the systematic condition - each voice was always presented with a specific picture of its referent (e.g. bifa spoken by talker A always co-occurred with a light-colored rectangular table). For the other half, the voice-to-referent mapping was randomized (random condition). Our hypothesis was that listeners can harness the systematicity of the mappings between voice and referent, when such systematicity exists. After training, we presented trials where the voice-to-referent mapping either matched that of training (congruent trials), or did not (incongruent trials). Participants' eye movements were monitored and looks to the target were used as a measure of lexical activation. Participants looked significantly more to the target on congruent than incongruent trials,  $t(40) = 2.23$ ,  $p = .031$ . This difference was more robust when congruency was determined based on gender (instead of a specific talker's voice),  $t(40) = 3.73$ ,  $p = .0006$ .

These results suggest that indexical information can be encoded in lexical representations, and can be used in referent selection.

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.. (1036) ..

**Lexical-coactivation of naming alternatives cannot be easily unlearned: evidence from extensive picture-word interference repetition.** FRANZISKA KURTZ<sup>1</sup>, HERBERT SCHRIEFERS<sup>2</sup>, ANDREAS MÄDEBACH<sup>1</sup> & JÖRG D. JESCHENIAK<sup>1</sup>; <sup>1</sup>Leipzig University, Germany; <sup>2</sup>Radboud University, Netherlands

Recent studies have shown that during object naming alternative object names, which are not produced by a speaker, become nevertheless phonologically co-activated during speech planning (e.g., the name bird when the produced name is duck and vice versa). The present study investigated whether the co-activation of such naming alternatives can be attenuated, when speakers consistently only use one particular name for a picture in a number of naming episodes. In two picture-word interference experiments we measured the phonological co-activation of basic-level naming alternatives when pictures were named at the subordinate-level (Experiment 1) and of subordinate-level naming alternatives when pic-

tures were named at the basic-level (Experiment 2). We implemented 25 repetition cycles and measured the phonological co-activation of naming alternatives at 4 different points in time. If the pattern of lexical activation is shaped by previous naming episodes, then the phonological co-activation of the non-target naming alternatives should decrease over repetitions. Contrary to this prediction, phonological co-activation effects remained stable across the whole experiment. This suggests that, at least for fully adequate alternative object names, lexical activation patterns are largely unaffected by recent naming episodes.

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**An ERP investigation of L2-L1 translation priming in beginning adult bilinguals.** GABRIELA MEADE<sup>1,2</sup> & PHILLIP J. HOLCOMB<sup>1</sup>; <sup>1</sup>*San Diego State University*; <sup>2</sup>*University of California, San Diego*

An ongoing debate centers around how beginning adult bilinguals process words in their second language (L2). Do they access the meaning of the L2 words directly or do they first activate the native language (L1) translation equivalents in order to access meaning? We addressed this question by using ERPs to investigate how newly learned L2 words influence processing of their L1 translation equivalents. We taught participants the meanings of 80 novel L2 (pseudo)words by presenting them with pictures of familiar objects. After three days of learning, participants were tested in a backward translation priming paradigm with a short (140 ms) stimulus onset asynchrony. As has been reported in more proficient bilinguals, L1 targets preceded by their L2 translations elicited faster responses and smaller amplitude negativities than L1 targets preceded by an unrelated L2 word. Critically, the ERP translation priming effect only began about 400 ms after presentation of the L1 target. This late onset is difficult to reconcile with theories that presuppose activation of the form of the L1 translation equivalent (which was processed prior to 400 ms). It is more consistent with cross-language priming at the level of semantics, suggesting that the new L2 words were directly activating their meanings. Implications for models of L2 processing in beginning bilinguals will be discussed.

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.. (1038) ..

**Learning foreign words depends on the learning method: Electrophysiological evidence.** ANA BELÉN GARCÍA-GÁMEZ<sup>1,2</sup> & PEDRO MACIZO<sup>1,2</sup>; <sup>1</sup>*University of Granada, Spain*; <sup>2</sup>*Mind, Brain and Behavior Research Center (CIMCYC), Spain*

Expert bilinguals have strong connections

between the semantic system (SS) and the vocabulary in their second language (L2). Previous research demonstrates that children subjected to a semantic learning protocol have stronger SS-L2 connections than those of children subjected to a lexical learning (Comesaña, Perea, Piñeiro, & Fraga, 2009). However, adults seem to prefer the lexical processing of new words learned in L2 (Chen, & Leung, 1989). The current work evaluated the degree to which the training method determines the strength of connections between new learned L2 words and their meanings. In one method (semantic training), adult learners received L2 words with pictures denoting their meaning and practiced with a semantic categorization task by indicating whether new words were exemplars of a semantic category. In another method (lexical training), learners received L1-L2 word pairs and performed a letter identification task (to decide whether L1-L2 words shared a grapheme). After training, the strength of SS-L2 connections was indexed with three evaluation tasks while brain waves were recorded: (a) a translation recognition task in which participants decided whether L1-L2 word pairs were translation equivalents, (b) picture naming tasks in L1 and L2, (c) backward (L2-L1) and forward (L1-L2) word translation tasks. In the three tasks, N400 modulations were found mainly in the group of participant subjected to the semantic training protocol relative to the lexical methods. Together, these results suggest that the learning strategy used to learn a foreign language determines the strength of SS-L2 connections. Implications for teaching a second language in children and adults are discussed.

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.. (1039) ..

**Bilateral differences in electrodermal activity.** SZABOLCS ZIMONYI<sup>1</sup>, KRISZTIAN KASOS<sup>2,1</sup> & ANNA SZEKELY<sup>1</sup>; <sup>1</sup>*Eötvös Loránd University, Hungary*; <sup>2</sup>*Doctoral School of Psychology, Eötvös Loránd University, Hungary*

Electrodermal activity (EDA) can be used as a psychological biomarker to situations with high arousal. This research places focus on bilateral differences in EDA. A recent study introduced the Multiple Arousal Theory, they found the right hand's EDA more dominant in personally relevant stressful events (Picard, 2015).

We used 44 right-handed university students in a lying game based on the Guilty Knowledge Test (Lykken, 1959). We placed EDA measurement devices (obimon.com) on the participants' left and right fingers. Four players took turns in hiding and seeking a reward. We asked the participants to say „no” whenever we ask them if the chocolate - serving as a reward - is hidden under a partic-

ular cup. There was only one person who knew if he/she was lying or not, the others didn't. Based on Lykken's findings, we assumed that the inner conflict caused by the lie would show in the EDA responses. We also hypothesized that the right hand would have a higher EDA SCR (skin conductance response) than the left hand.

EDA response measured on the left hand of liars did not differ significantly from the non-liars, in both cases typical electrodermal responses were found. Lateral differences were detected: we measured significantly higher EDA response on the left hand as compared to the right ( $p=0.039$ ). This effect was present in both liars and non-liars.

EDA differences between liars and non-liars suggested by the Guilty Knowledge Test could not be detected in the current sample. Individual characteristics as well as sample size might hinder results presented here. At the same time results indicate that bilateral differences are present, but contrary to Picard's results the left hand's EDA response was more pronounced. The conflict in results might be due to differences in methodology.

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.. (1040) ..

#### Age and motivational factors in a lying game.

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Based on electrodermal activity (EDA) we can deduce the function of the sympathetic branch of the autonomic nervous system, signaling emotional psychological states for example those associated with lying. Our previous results indicate that there is a higher electrodermal activity in the motivated condition of a Stroop task than during the baseline condition in university students (Gönye et al., 2015). Based on the above we hypothesized that the magnitude of electrodermal response when lying will be higher in children than in university students. Moreover, we expected that motivation will have an effect on electrodermal activity in all age groups.

In the present study electrodermal activity measures were collected from university students, primary school students and preschoolers in a lying game based on the Guilty Knowledge Test (Lykken, 1959). Participants hid an object under one of three glasses. Simple questions regarding whereabouts of the object were asked from the participants, their instructions were to hold back this information. Successful hiding was rewarded only in the motivated condition.

Surprisingly, there was no significant difference

between the EDA amplitude of lying and telling the truth in any of the tested age groups. On the other hand, response of university students showed significantly higher EDA during the motivated condition as compared to the baseline ( $p=0.036$ ). This difference was not present in the younger age groups.

The fact that none of the age groups showed EDA response when lying might be due to the fact, that the lying game we used did not evoke the classical guilt arousal, as described by Lykken. Data regarding the relationship between age and EDA is limited in the literature. Our results suggest that the typical EDA pattern signaling arousal changes while lying might develop with age.

This work was supported by ELTE-PPK.

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.. (1041) ..

#### The role of the DRD4 7 repeat allele in flow proneness.

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The 7 repeat allele of the dopamine D4 receptor (DRD4) gene was associated with many human traits, however, explanation for links between the "magnificent 7" and different traits is still a mystery (Pappa et al., 2015). Our previous results showed that carriers of the 7 repeat allele produce slower responses in speeded tasks (Szekely et al., 2011), and are less impulsive (Varga et al., 2012). Recent findings implicate 7 repeat carriers are more adaptive and live longer in both mouse and human studies (Grady et al., 2013).

Recent findings link individual differences in flow proneness to the dopamine D2 receptor variations (Gyurkovics et al., 2016), however, association between flow proneness and the DRD4 7 repeat allele has not been explored to date. We hypothesized that 7 repeat carriers are more prone to flow experiences, since they devote cognitive resources to efficiently adapt to changes in the environment.

222 females and 85 males participated in our psychogenetic association study. The Swedish Flow Proneness Questionnaire was used to characterize the number of flow experiences in 3 domains of everyday life. Non-invasive DNA samples were collected to investigate the link between individual differences of flow proneness and the presence of

the 7 repeat allele in males and females.

Our results show that higher flow proneness in all life domains were associated with the 7 repeat allele in women, this effect was most pronounced with regards to flow proneness in leisure time ( $p=0.002$ ). In man, no association was observed.

Our findings fit well with previous results suggesting that 7 repeat carriers have slower responses, are less impulsive and live longer. Key element of these characteristics could be the value of better adaptation skills.

This work was supported by ELTE-PPK and by the MTA postdoctoral scholarship awarded to Eszter Kotyuk.

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.. (1042) ..

**Implicit sequence-learning of effects.** CLARISSA LUSTIG & HILDE HAIDER; *University of Cologne, Germany*

In the field of implicit learning, several studies support the assumption that associations between responses and task-irrelevant effects can enhance learning within an implicit learning paradigm (R-E-learning; Hoffmann, et al., 2001). Furthermore, action-effect learning seems to play an important role for the development of explicit knowledge in an implicit learning task (Haider, et al., 2014).

What has been unclear, yet, is why redundant effects enhance learning. A contingent relation between responses and effects seems to be required for learning (Haider et al., 2014; Hoffmann et al., 2001). Stephan et al. (2015) showed that learning a sequence of effect tones led to a benefit when participants afterwards had to learn a congruent motor sequence. Lepper et al. (2008) provided evidence that a sequence of task-relevant effects can be learned in an implicit learning situation. What remains open is whether a sequence of task-irrelevant effect-tones can be learned in advance without an explicit instruction and whether the profit of this learning requires the establishment of the R-E mapping.

In order to investigate this issue, participants were trained with pure random material while performing a serial reaction time task (Nissen & Bullemer, 1987). After each response an effect-tone was presented which unbeknownst to the participants followed a regular sequence. After three blocks, the participants were switched to a regular response sequence that also produced the formerly presented tone sequence. The control condition varied in different experiments. Results show that participants in the experimental condition responded faster than participants in the respective control condition. They also showed higher amounts of knowledge in a generation task. Thus, the findings

suggest that participants profit from a sequence of task-irrelevant effect-tones even when this is not explicitly learned and consistently mapped to the responses.

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.. (1043) ..

**Introspective access to implicit attentional shifts.** GABRIEL REYES<sup>1</sup> & JÉRÔME SACKUR<sup>2</sup>; <sup>1</sup>*Universidad del Desarrollo, Chile*; <sup>2</sup>*École des Hautes Études en Sciences Sociales, France*

Literature in metacognition has systematically rejected the possibility of introspective access to complex cognitive processes. This situation derives from the difficulty of experimentally manipulating cognitive processes while abiding by the two contradictory constraints. First, participants must not be aware of the experimental manipulation, otherwise they run the risk of incorporating their knowledge of the experimental manipulation in some rational elaboration. Second, we need external, third person perspective evidence that the experimental manipulation did indeed impact on some relevant cognitive processes. Here, we study introspection during visual searches, and we try to overcome the above dilemma by presenting a barely visible, “pre-conscious” cue just before the search array. We aim to influence the attentional guidance of the search processes while participants remain unaware of it. Results show that introspection of the complexity of a search process is driven in part by subjective access to its attentional guidance.

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.. (1044) ..

**Can inconsistent US influence EC effect?** ADRIANA ROSOCHA<sup>1</sup>, ROBERT BALAS<sup>1</sup> & JOANNA SWEKLEJ<sup>2</sup>; <sup>1</sup>*Institute of Psychology Polish Academy of Sciences, Poland*; <sup>2</sup>*University of Social Sciences and Humanities, Warsaw, Poland*

This abstract presents research into preference and attitude shaping using evaluative conditioning. EC is an effective mechanism of acquisition and modification of attitudes and it refers to a change in liking of an initially neutral stimulus through repeated pairings with a valenced stimulus. Relatively little attention has been devoted to the characteristic of US stimuli that affects the evaluations of EC. We conceptually replicated some of the findings of Rydell et al. (2006) into the possibility of having an inconsistent attitude towards an object. We have observed significant differences between the explicit and implicit attitude when the preceding stimulus was positive and the information itself negative. Then we checked if an inconsistent US will influence EC effect by presenting USs with neutral stimuli and measured the explicit



and implicit attitudes. The results show that only congruent US elicited evaluative conditioning effect for the neutral CS.

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.. (1045) ..

**LabVanced - A new powerful platform for professional online studies.** HOLGER FINGER, DORENA DIEKAMP, CASPAR GOEKE & PETER KÖNIG; *Universität Osnabrück*

Online-based research has recently gained increasing attention from various fields of research in the cognitive sciences. New possibilities such as online crowdsourcing, open data repositories, and online analysis offer rich possibilities to improve, validate, and speed up research. However, until today there is no cross-platform integration of these sub-systems. Furthermore, implementation of online studies still suffers from the complex implementation (server infrastructure, database programming, etc).

Here we propose a new JavaScript framework that enables researchers to conduct any kind of behavioral research in the browser without the need to program a single line of code. In particular, our framework offers the possibility to manipulate and combine the experimental stimuli via a graphical editor directly in the browser. Moreover, the framework features an action-event system that can be used to handle user interactions, interactively change stimulus properties or store participants' responses. Besides traditional recordings such as reaction time, mouse and keyboard presses, the tool offers webcam based eye tracking.

Additionally, our framework also takes care about the participant recruitment, via crowdsourcing platforms such as Amazon Mechanical Turk. Furthermore, the build in functionality of google translate will ensure automatic text translations of the experimental content. Thereby, thousands of participants from different cultures and nationalities can be recruited within hours. Finally the recorded data can be visualized and cleaned online, and then exported into the desired formats (csv, xls, sav, mat).

The framework was designed such that studies can be used interchangeably between researchers. This will support not only the idea of open data repositories, but also constitutes the possibility to share and reuse the experimental designs such that the validity of the paradigms will be improved. In summary, we introduce a new powerful JavaScript framework for improving and accelerating online research.

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.. (1046) ..

**Comprehension, attention and emotion: A new perspective of deception detection.** GEOFFREY DURAN, CLÉMENT GILBERT-GUERIN, MARYLOU MANTEL, ISABELLE TAPIERO & GEORGE ANDREW MICHAEL; *Laboratoire d'Etude des mécanismes cognitifs, Université Lumière Lyon 2 France*

Lies represent over 30% of interactions and failures to detect them could have serious consequences. Deception and its detection could be understood as a dynamic and interactive process during which liars' discourse and behavioral displays are monitored, processed and evaluated. Consequently, deception detection would partly depend on the detector's skills. Today, reasons why some people are better than others in detecting deception remain unclear. The purpose of this study was to identify the cognitive mechanisms that are associated with the ability to detect other's lies.

Twenty men and sixty-eight women participated in the experiment at this moment. They were required to complete a questionnaire of self-monitoring scale and one on their capacity to inhibit interfering thoughts (White Bear Suppression Inventory). They, then, were required to complete a truth-lie judgment task. It consisted in 48 videos where individuals told the truth or a lie either about what they did the week-end before the recording session (action) about emotions they experienced during an emotionally-strong event (emotion), about their opinion on topics of current debate (opinion). They were then required to complete audio-video tasks specifically designed to evaluate recognition of emotions, mental imagery, attention, discourse comprehension and the capacity to inhibit interfering information from memory. Finally, they completed an abbreviated IQ test and a task of working memory update. Signal detection analyses will be carried out to unravel the ability to distinguish false from truthful videos ( $d'$  index) and response trends (C criterion). Then we plan to carry out multiple regression analyses with all above-mentioned variables as independent variables and Index  $d'$  and Criterion C as dependent variables. Final results will be presented and discussed at the ESCOP event.

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.. (1047) ..

**Physical activity mediates the relationship between extraversion and mean driving speed.**

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**Background:** Studies have linked physical activity to performance on driving-related tasks; however, its direct effect on driving performance has not been examined. Personality has also been associated with driving performance and physical activity, but the results are unclear. This study aimed to elucidate the relationships between physical activity, personality and driving performance. **Methods:** Participants' (n = 45) self-reported physical activity levels and personality were assessed with the International Physical Activity Questionnaire and Eysenck Personality Questionnaire respectively. Scores on these questionnaires were compared with performance on a simulated driving task. **Results:** Results showed that extraversion and physical activity significantly predicted mean speed, with physical activity mediating the relationship between extraversion and driving performance. **Discussion:** These findings suggest that extraverted and physically-active drivers are more likely to engage in risky driving behaviour. A follow-up study will assess whether this behaviour results in an increased propensity for motor vehicle accidents.

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.. (1048) ..

**The Lexical Bias Effect during Speech Production in the First and Second Language.** WOUTER BROOS, WOUTER DUYCK & ROBERT HARTSUIKER; *Ghent University, Belgium*

The lexical bias effect is the tendency for people to make phonological speech errors that result in existing words. Several studies have argued that this effect arises from a combination of factors: the self-monitoring system covertly weeding out more nonword than word errors and feedback of activation during speech production biasing towards lexical outcomes. Moreover, lexicality of the context has been shown to influence the occurrence of the lexical bias effect (Hartsuiker, Corley, & Martensen, 2005), supporting a role for monitoring. Do speakers use monitoring and feedback to the same extent in a second language (L2)? To address that question, we tested whether people also show the lexical bias effect when speaking in a second language (L2) and if so, whether the effect is also modulated by context lexicality. Additionally, we tested whether recent exposure to existing words in L2 influences such a lexical bias effect. We observed a

lexical bias effect in L1 but not in L2 in Experiment 1. Moreover, the lexical bias effect in L1 was indeed modulated by context. In Experiment 2, more existing L1 and L2 words were presented during the experiment. Now, the lexical bias effect was weaker and not significant in L1, whereas L2 did show a significant lexical bias effect. In other words, the lexical bias effect is affected by the amount of exposure to existing L2 words where the effect decreases in L1 but increases in L2. In conclusion, the change in the lexical bias effect seems to be caused by recent exposure to existing L2 words. This suggests that recent exposure causes the importance of lexicality as a monitoring criterion to increase in L2 and to decrease in L1.

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.. (1049) ..

**Within-subject mediation analysis for experimental data in cognitive psychology and neuroscience.** MATTI VUORRE & NIAL BOLGER; *Columbia University, United States of America*

Within-subject mediation analysis for experimental data in cognitive psychology and neuroscience

**Background**

Statistical mediation allows researchers to investigate potential causal effects of experimental manipulations through intervening variables. It is a powerful tool for assessing the presence and strength of postulated causal mechanisms. Although mediation is commonly used in certain areas of psychology, it is rarely applied in cognitive psychology and neuroscience. One reason for the scarcity of applications is that these areas of psychology commonly employ within-subjects designs, and it is only recently that statistical mediation has been worked out satisfactorily for such designs.

**Method**

Here, we draw attention to the importance and ubiquity of mediational hypotheses in within-subjects designs, and we present a free and open source software package for conducting Bayesian within-subjects mediation analyses in the R programming environment. The software package is easy to use and provides methods for preparing data for multilevel mediation analysis, estimating the mediation model, and summarizing and plotting the results.

**Results**

We use experimental data from cognitive psychology to illustrate the practice and benefits of within-subject mediation for theory testing and comparison.

**Discussion**

We present an easy to use software package for the R programming language for estimating,

summarizing and plotting mediation models for within-subject experimental designs. An empirical example illustrates the use of the software package and interpretation of the results.

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.. (1050) ..

**Methodology of Performance Scoring in the d2 Sustained-Attention Test: Cumulative-Reliability Functions and Practical Guidelines.** MICHAEL B. STEINBORN<sup>1</sup>, ROBERT LANGNER<sup>2</sup>, HAGEN C. FLEHMIG<sup>3</sup> & LYNN HUESTEGGE<sup>1</sup>; <sup>1</sup>University of Wuerzburg, Germany; <sup>2</sup>University of Duesseldorf, Germany; <sup>3</sup>University of Dresden, Germany

We provide a psychometric analysis of commonly used performance indices of the d2 sustained-attention test, and give methodical guidelines and recommendations, based on this research. We examined experimental effects of repeated testing on performance speed and accuracy (omission and commission errors), and further evaluated aspects of test reliability by means of cumulative reliability function (CRF) analysis. The results indicate that performance is sensitive to change, both within and between sessions, since performance reproducibly declined with time-on-task but improved with repeated testing. Obviously, these effects did not severely affect test reliability, since perfect score reliability was observed for speed (and was even preserved with half the test length) while accuracy (omission and commission errors) and variability scores were problematic with respect to reliability. Our urgent recommendations to researchers and practitioners are that (1) only the speed score is eligible for reliable assessment, that (2) error scores should only serve to check for aberrant behavior, and that (3) variability scores might not be used at all. Given the exceptional reliability of performance speed, (4) test length may be reduced up to 50%, if necessary to serve purposes of population screening and field assessment.

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.. (1051) ..

**Fractionating reaction times to probe the validity of the Drift Diffusion Model parameters.** GABRIEL WEINDEL<sup>1,2</sup>, ROYCE ANDERS<sup>1</sup>, F.-XAVIER ALARIO<sup>1</sup> & BORIS BURLE<sup>2</sup>; <sup>1</sup>Laboratoire de Psychologie Cognitive, Aix-Marseille Université, France; <sup>2</sup>Laboratoire de Neurosciences Cognitives, Aix-Marseille Université, France

The sequential sampling framework is a cognitive-behavioral modeling approach that can account for a large variety of experimental data. These models have an important place in psychology as empirical tools to infer cognitive processes from data, making them particularly useful for fun-

damental research, but also clinical investigation. The framework assumes that choices between response alternatives are derived from a progressive, noisy accumulation of evidence toward a decision threshold. For example, the Drift Diffusion Model (DDM, Ratcliff, 1978) has been emphasized for perceptual decision-making, and describes this process by several key parameters: speed of accumulation (drift), decision threshold (threshold), and a time external to decision (which accounts for stimulus encoding and response execution,  $t_0$ ). Despite its popularity however, few tests have focused on the interpretative validity of the  $t_0$  parameter. We conducted empirical tests of the DDM's decomposition of response times into decision time (drift / threshold) versus non-decision time ( $t_0$ ) in human participants. We designed a two-alternative forced choice experiments in which the by-trial reaction times could be fractionated into pre-motor and motor times (MT), based on the onset of muscular activity from the electromyographic (EMG) recordings, which should be contained in the  $t_0$  parameter. MT means and standard deviations are strongly correlated with the model-estimated  $t_0$  parameter values, as well as its inter-trial variability. In addition, fitting the DDM to only the pre-motor times (hence selectively removing a part of  $t_0$ ), further confirmed that mainly parameter  $t_0$ 's estimation is affected. These results support the interpretation that parameter  $t_0$  accounts for motor time, and that the other parameters, such as drift and threshold, correspond to processes that precede motor execution. However, MTs were also sensitive to decision-related manipulations such as speed instructions or stimulus difficulty, questioning the independence between decision and non-decision processes.

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.. (1052) ..

**Perceptual control models of pursuit manual tracking demonstrate temporal stability in parameters and simulate individual performance.** MAXIMILIAN PARKER<sup>1</sup>, SARAH TYSON<sup>1</sup>, ANDREW WEIGHTMAN<sup>1</sup>, BRUCE ABBOTT<sup>2</sup>, RICHARD Emsley<sup>1</sup> & WARREN MANSELL<sup>1</sup>; <sup>1</sup>The University of Manchester, United Kingdom; <sup>2</sup>Indiana-Purdue University Fort Wayne, IN, US

Computational models of pursuit tracking performance show that participants display idiosyncrasies in control strategies. However, studies have not investigated whether these strategies can be reliably characterised by estimated control parameters that show temporal stability in test-retest paradigms nor whether models demonstrate individual-specificity. In the current experiment 20 healthy adults completed three blocks of 15 one minute tracking trials (Powers, 2008). Block

3 occurred at least one week after blocks 1 and 2. Blocks 1 data were used to train 20 computational perceptual control theory (PCT) models using a least means squares approach. Blocks 2 and 3 provided validation data for the models. Model parameter estimates showed both inter-individual variability (partial  $\eta^2$  ranged from .464 to .697) and intra-individual consistency (Cronbach's  $\alpha$  ranged from .880 to .976). Validation data were simulated more accurately by individual models than by general models. We argue that test-retest reliability in model parameters and performance should be a criterion for evaluation of computational model performance.

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.. (1053) ..

**The costs of caution: How strategic changes influence the correlations between RT costs and error costs in choice RT tasks.** CRAIG HEDGE, GEORGINA POWELL, ALINE BOMPAS, SOLVEIGA VIVIAN-GRIFFITHS & PETROC SUMNER; *Cardiff University, United Kingdom*

Many tasks in psychology require individuals to make rapid decisions between competing response options in two or more conditions (e.g. Stroop, lexical decision, task switching). Performance is traditionally measured by differences in response time (RT) or error rates between conditions. The resultant RT costs and error costs are often interpreted similarly, and individual differences studies may use either as an index of performance in a given domain. However, in a meta-analysis of 70 effects from widely used tasks, we show that the correlation between RT costs and error costs is typically small, and highly heterogeneous. This indicates that RT costs and error costs are not interchangeable measures of individual performance. We consider these findings within the framework of sequential sampling models, such as the drift-diffusion model, which capture RT costs and error costs in two distinct ways. If individuals differ only in their ability to process information (drift rates) then a positive correlation between RT costs and error costs is expected. However, a negative correlation is produced if participants differ only in the amount of evidence they require to make a decision. Based on this framework, we tested two predictions in which we manipulated participants' decision criteria. First, we observed a more positive correlation between RT costs and error costs when task instructions emphasised speed compared to instructing participants to be both fast and accurate. Second, we observed a more positive correlation in a Simon task when congruent and incongruent trials were intermixed within blocks compared to when they were performed in separate blocks. We caution against interpreting RT costs or error costs in

isolation as 'pure' measures of cognitive constructs.  
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.. (1054) ..

**ELF: A new measure of response capture.** THIBAUT GAJDOS<sup>1</sup>, KAREN DAVRANCHE<sup>1</sup> & MATHIEU SERVANT<sup>2</sup>; <sup>1</sup>*Aix Marseille Univ, CNRS, LPC, Marseille*; <sup>2</sup>*Department of Psychological Sciences, Vanderbilt University*

Response capture is a widespread and extensively studied phenomenon, in particular in decision tasks involving response conflict. Its intensity is routinely quantified by Conditional Accuracy Function (CAF). We argue that this method might be misleading, and propose an alternative approach, the Error Location Function (ELF). While CAF provides the error rate by quantile of reaction time (RT), ELF represents the share of total errors below each quantile of RT. We derive from the ELF an index of response capture, the Error Location Index (ELI), which represents the area below the ELF. Using simulations of computational models, we show that ELF and ELI specifically quantify variation in response capture.

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.. (1055) ..

**Semantic Surprisal in Real-World Comprehension.** DIEGO FRASSINELLI<sup>1</sup>, YE ZHANG<sup>2</sup>, JYRKI TUOMAINEN<sup>2</sup> & GABRIELLA VIGLIOCCO<sup>2</sup>; <sup>1</sup>*University of Stuttgart, Germany*; <sup>2</sup>*University College London, UK*

Semantic surprisal (i.e., a measure of how unpredictable a word is) has been shown to be a good predictor of the cognitive effort required to read a word in sentence contexts (Frank et al., *Brain & Language*, 2015).

The aim of our study is to test the cognitive validity of surprisal (as derived from text corpora) in more naturalistic stimuli such as longer and more complex sentences, but also both in visual, auditory and audio-visual language.

103 pairs of sentences (context + target) were extracted from the British National Corpus and pre-tested. We implemented the surprisal n-gram model (by Frank et al., 2015) by training it on a 16-billion tokens corpus, and we computed surprisal for each of the content words in the target sentences.

In a first EEG study, 9 participants silently read each sentence word-by-word. We analysed the data (604 words) using a linear-mixed-effects model. The N400 amplitude was the predicted variable; surprisal, frequency, length, position in the sentence and in the experiment were main factors and random slopes and intercepts under Subject and Item.

The analysis shows a significant negative effect of surprisal ( $\beta = -.33$ ,  $p < .01$ ): words with higher surprisal scores had greater N400. Moreover, the interaction between surprisal and word order was significant ( $\beta = -.02$ ,  $p < .05$ ): by the end of the sentence, the surprisal scores drop.

Thus, we successfully replicated previous studies showing that surprisal is a good predictor of N400 for longer and more complex sentences. In a second experiment, we will present the stimuli in an audio-only and audio-visual format (performed by an actor). We expect: a) comparable results between written and spoken modalities; b) a reduction in model fit for the audio-visual condition given the introduction of extra communicative information (e.g., gestures, facial expressions) to which the language model is not exposed to.  
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.. (1056) ..

**How brief exposure of bilinguals to one language affects their performance in the second language: General vs. items-specific effects.** HAMUTAL KREINER<sup>1</sup> & TAMAR DEGANI<sup>2</sup>; <sup>1</sup>Ruppin Academic Center, Israel; <sup>2</sup>University of Haifa, Israel

One of the fundamental challenges bilinguals face is being able to shift between the languages they speak flexibly and appropriately. Aiming to explore the mechanisms that help bilinguals cope with this challenge, our research examines the interaction between long- and short-term factors affecting bilinguals' performance. Recent findings (Kreiner & Degani, 2015) showed that both long-term experience and recent experience of brief exposure to the first-language (L1) increased bilinguals' lexical access difficulties in the second-language (L2). The current study examined whether lexical access in L1 is similarly affected by brief exposure to L2 and whether the brief exposure effect reflects item-based mechanisms or a more general, non-item-specific, mechanism. In two experiments bilingual participants named pictures in their L1, then the experimental group was exposed to L2 while the control group was not, and finally all participants named in L1 another set of pictures. Experiment 1 examined Hebrew-English speakers (70) and L2 exposure consisted of a comprehension task, whereas Experiment 2 examined Arabic-Hebrew speakers (48) and L2 exposure consisted of a production task. Half the words in the post-exposure naming task were new words and half were repeated from the exposure task. In both comprehension and production accuracy rates in L1 were lower following exposure to L2 compared to baseline, indicating that brief exposure to L2 hindered performance in L1. Critically, the exposure effect was not limited to repeated items, suggesting that brief exposure operates in a global way

beyond item-based mechanisms. Experiment 2 further revealed that following exposure to Hebrew participants were more likely to name pictures in Hebrew (instead of Arabic) in both repeated and new items, suggesting that errors were not driven by activation of specific items in Hebrew. The findings highlight the dynamic nature of both long- and short-term mechanisms operating at the bilingual language system.

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## Poster Session I Top1, Sunday, 18:30 – 21:00

.. (1101) ..

**Orthographic processing deficits in children with isolated and combined reading and spelling deficits: an ERP-study.** HEIKE MEHLHASE, SAROLTA BAKOS, GERD SCHULTE-KÖRNE & KRISTINA MOLL; *Department of Child and Adolescent Psychiatry, University Hospital of Munich, Campus City Center*

### Background

In German, isolated deficits in reading (fluency) or spelling are as frequent as combined reading and spelling problems. These dissociations indicate that reading and spelling problems are likely to be associated with different underlying cognitive deficits. Children with isolated reading deficits seem to have intact word-specific representations, as they show no difficulties in spelling. Their deficits in reading fluency may result from disrupted or slowed down access to these representations. In contrast, children with spelling deficits seem to have problems in building-up word-specific orthographic representations. The aim of the current ERP-study was to examine the exact time course during orthographic processing using EEG in children with isolated and combined reading and spelling problems.

### Method

Children (4th grade) with isolated reading, isolated spelling and combined reading and spelling problems were compared to children with age appropriate literacy skills while performing a variant of the Reicher-Wheeler paradigm: children had to indicate which of two letters occurred at a given position in a previously presented word (e.g., ARZT), legal pseudoword (e.g., ALZT), illegal pseudoword (e.g., AVZT), or nonword (e.g., BRZT). Group differences in lexical processing can be revealed by comparing words and pseudowords, while differences between legal and illegal pseudowords indicate orthographic sensitivity at the sublexical level.

### Results

Event-related potentials (ERPs) related to lexical and sublexical orthographic processing are currently being analyzed. For poor spellers we expect smaller N200 amplitude differences between legal and illegal pseudowords and smaller N400 amplitude differences between words and legal pseudowords compared to the control group. For children with isolated reading deficits we expect similar amplitude differences as the control group given their intact orthographic representations, but eventually delayed latencies indicating slowed-down access.

#### Discussion

The results shed light on the distinct orthographic processing deficits associated with deficits in reading versus deficits in spelling.

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.. (1102) ..

**Modulation of subjective evaluation by predictive information.** KAJORNVUT OUNJAI<sup>1</sup>, SHUNSUKE KOBAYASHI<sup>2</sup> & JOHAN LAUWEREYNS<sup>1</sup>; <sup>1</sup>*Kyushu University, Japan*; <sup>2</sup>*Fukushima Medical University, Japan*

**BACKGROUND.** It has been well established that predictive information influences decision-making in a variety of paradigms based on perceptual and mnemonic processing. However, with respect to evaluative decision-making, it is less clear how predictive cues might affect the evaluation. In accordance with studies of reward expectation and dopamine processing, one might posit a “dopamine hypothesis,” with higher evaluations for stronger dopamine reward-related signals. Conversely, in accordance with studies of framing, one might propose a “contagion hypothesis,” with higher evaluations for stronger reward anticipation. To investigate how predictive information influences our subjective rating, we designed an evaluative decision-making paradigm, with naturalistic food images as stimuli, using predictive cues.

**METHOD.** In each trial, we used a predictive cue to generate an expectation about the upcoming target image. The color of the cue indicated the predictive validity (either 100% or 50% reliability); the shape of the cue indicated the predicted valence of the target image (either appetitive or aversive). We also varied the length of the delay between the predictive cue and the target image (either 1s or 9s). The participants were asked to rate the target food images on a continuous scale from 1 to 10 using a joystick. We recorded the evaluation, the reaction time, and several eye-tracking parameters.

**RESULTS.** The validity of the predictive cues significantly affected both the evaluation score and the reaction times, symmetrically for appetitive and aversive images. The absolute mean evaluation score for target pictures was the highest after a

100% valid prediction and the smallest after a 50% invalid cue. Conversely, the reaction time was the fastest after a 100% valid prediction and the slowest after a 50% invalid cue.

**DISCUSSION.** The pattern of results was consistent with that predicted by the “contagion hypothesis,” but not the “dopamine hypothesis”.

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.. (1103) ..

**Neurophysiological differences between children with different literacy profiles in a delayed naming ERP-task.** SAROLTA BAKOS, HEIKE MEHLHASE, GERD SCHULTE-KÖRNE & KRISTINA MOLL; *University Hospital of the University of Munich, LMU, Germany*

#### Background:

Prevalence studies indicate that reading and spelling problems can dissociate. The dissociation between literacy components is also recognised in the classification system ICD-10, which differentiates between reading and spelling deficits (cRSD) and isolated spelling deficits (iSD). Thus, reading and spelling problems are likely to be associated with different underlying cognitive deficits. While deficits in spelling are related to difficulties in building-up word-specific lexical representations, children with reading problems might have intact representations but are slow in accessing them. A deficit in lexical access in individuals with reading disorder is supported by findings showing that reading deficits are associated with slow naming speed (e.g. rapid automatized naming; RAN). In order to investigate the exact time course of lexical access in the different groups we applied a delayed naming task while obtaining event-related potentials (ERPs).

#### Method:

Three groups of 4th Graders were examined: 21 iSD, 35 cRSD and 35 typically developing (TD) children. Participants performed a delayed naming task including pictures and numbers. ERPs related to visual processing (until 150 ms), lexical-semantic access (150-275 ms) and phonological encoding (275-450 ms) are compared between groups.

#### Results:

Data are currently being analysed. First results indicate comparable visual and lexical-semantic processes in the groups (0-275 ms). In line with the phonological deficit hypothesis, we found significant differences in the ERP sequence between children with reading deficits (cRSD) and TD children after 275 ms, indicating deficits in phonological encoding. There was no difference between the ERPs of TD and iSD children.

#### Discussion:

The findings inform about the heterogeneous group of children with literacy difficulties by spe-

cifying deficits in lexical access in a delayed naming task.

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.. (1104) ..

**The interference control in children with an Attention deficit/hyperactivity disorder.** AURELIE GRANDJEAN<sup>1</sup>, DAVID DA FONSECA<sup>2</sup> & LAURENCE CASINI<sup>1</sup>; <sup>1</sup>Aix-Marseille Université - CNRS, France; <sup>2</sup>Aix-Marseille Université - APHM, France

Background: The Attention deficit/hyperactivity disorder (ADHD) is one of the most common developmental disorders diagnosed in childhood and it often persists into adulthood. It corresponds to symptoms of inattention, hyperactivity and impulsivity. These symptoms lead to great difficulties in school learning, and in social and familial relationships.

A deficit in "interference control" is commonly found in children with ADHD. This has mainly been interpreted as difficulties in inhibiting inappropriate responses. However, interference control relies not only on the ability to inhibit automatic but inappropriate responses but also on the subject susceptibility to trigger automatic responses. Consequently, we used sophisticated analysis allowing us to separately investigate these two processes in children with ADHD. Moreover, we also investigated the effect of the methylphenidate (MPH), the most prescribed medication.

Methods: Sixty-five children took part into this experiment: 25 children with ADHD without medication, 20 children with ADHD under MPH, and 20 control children. We compared their performance in a conflict task (the Simon reaction time task). Besides classical measures such as mean reaction times (RT) and error rates, we used dynamic analyses of performance which allowed us to better dissociate the strength of the automatic response and the efficiency of the automatic response inhibition.

Results and discussion: Our data have shown that 1/ difficulties in cognitive control of ADHD children would be due to both a higher susceptibility to trigger automatic responses and an inhibition deficit, and 2/ MPH improved the selective inhibition of automatic responses but did not modify the strength of automatic responses. This suggests that these two processes would rely on different neurotransmitter systems, and more specifically, that the selective inhibition only would rely on dopaminergic system since MPH is supposed to act on the reuptake of dopamine in striatum.

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.. (1105) ..

**Development of Tool use in Childhood.**

CHRYSTELLE REMIGEREAU<sup>1,2</sup>, ARNAUD ROY<sup>2,3</sup>, ORIANNE COSTINI<sup>4,5</sup>, CHRISTOPHE JARRY<sup>2</sup>, FRANÇOIS OSIURAK<sup>6,7</sup> & DIDIER LE GALL<sup>2,8</sup>; <sup>1</sup>University of Lyon, Institute of Psychology, France; <sup>2</sup>University of Angers, Psychology Laboratory (LPPL, EA 4638), France; <sup>3</sup>Reference Center for Learning Disabilities and Neurofibromatosis Clinic, Nantes University Hospital, France; <sup>4</sup>Psychology Laboratory of Perception, CNRS UMR 8158, Paris, France; <sup>5</sup>Neurology Service, Rothschild Ophthalmological Foundation, Paris, France; <sup>6</sup>Laboratory for the Study of Cognitive Mechanisms (EMC EA 3082), University of Lyon, France; <sup>7</sup>University Institute of France, Paris, France; <sup>8</sup>Department of Neurology, Angers University Hospital, Angers, France

It is well-known that even toddlers are able to manipulate tools in an appropriate manner according to their physical properties. The ability of children to make novel tools in order to solve problems is, however, surprisingly limited. In adults, mechanical problem solving (MPS) has been proposed to be supported by "technical reasoning skills", which are thought to be involved in every situation requiring the use of a tool (whether conventional or unusual). The aim of this study was to investigate the typical development of real tool use (RTU) skills and its link with technical reasoning abilities in healthy children. Three experimental tasks were adapted from those used with adults: MPS (three different apparatus), RTU (10 familiar tool-object pairs), and functional knowledge (FK; 10 functional picture matching with familiar tools previously used). The tasks were administered to 85 healthy children divided into six age groups (from 6 to 14 years of age). The results revealed that RTU ( $p=0.01$ ) and MPS skills improve with age, even if this improvement differs according to the apparatus for the latter ( $p<0.01$  for the Hook task and  $p<0.05$  for the Sloping task). Results also showed that MPS is a better predictor of RTU than FK, with a significant and greater weight (importance weight: 0.65; Estimate  $\pm$  Standard Error: 0.27  $\pm$  0.08). Our findings suggest that RTU and technical reasoning develop jointly in children, independently from development of FK. In addition, technical reasoning appears partially operative from the age of six onward, even though the outcome of these skills depends of the context in which they are applied (i.e., the type of apparatus).

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.. (1106) ..

**Context-specific processing and cross-category phonological effects in Mandarin reading aloud: a GAMM model of ERPs.** JESSIE SOPHIA NIXON<sup>1</sup>, JACOLIE VAN RIJ<sup>2</sup>, XIAOQING LI<sup>3</sup> & YIYA CHEN<sup>4</sup>; <sup>1</sup>New Zealand Institute of Language, Brain & Behaviour (NZILBB); <sup>2</sup>University of Groningen; <sup>3</sup>Chinese Academy of Science; <sup>4</sup>University of Leiden

**Background.** Phonetic realisation of speech sounds depends on context (e.g. /t/ is aspirated in 'top', but unaspirated in 'stop'). Does processing involve speech categories (/t/) or context-specific forms (unaspirated [t])? Beijing Mandarin Tone 3 (T3) contour is usually low (low T3), but preceding another T3 syllable, is rising (sandhi T3). Importantly, Tone 2 (T2) contour is also rising. So, T2 and sandhi T3 are different tones, but phonetically similar, allowing manipulation two types of phonological similarity: phonetic and phonemic.

**Previous ERP studies** investigating phonemic overlap in reading aloud have found effects at around 300-500ms. The present study addressed two questions: how and when context-dependent phonetic variation is processed; whether processing involves cross-category phonological effects (i.e. effects of phonetically similar, but phonemically different primes).

**Method.** ERPs were recorded as 24 native Beijing Mandarin speakers read aloud words preceded by masked primes. Targets were T2 words (e.g. ??, yu2gang1). Primes were T3 words (no tone category overlap). Primes either matched targets' tonal contour (sandhi T3, match condition; ??, yu3shui3) or mismatched (low-T3, mismatch condition; ??, yu3yi1). Any difference between conditions indicates activation of the context-specific tonal contour, determined by the second character.

**Results.** ERPs were analysed using Generalised Additive Mixed Modelling (GAMM; Wood, 2006). To avoid speech artefacts, only data preceding 500ms were analysed. Like previous phonological studies, divergences emerged 300-400ms, as well as at 100ms. Prime type was significant across the scalp, indicating context-specific (phonetic) processing.

**Discussion.** The different pattern of effects between match and mismatch primes indicates context-specific processing of masked primes during reading aloud. Even for brief, masked primes, the context-specific phonetic form is processed. Moreover, activation of this variant influences processing of targets of a different tone category, demonstrating cross-category phonological effects. The time course is similar to phonemic processing. Email: jess.s.nixon@gmail.com

## Poster Session I

### Top2, Sunday, 18:30 – 21:00

.. (1107) ..

**The effects of mindfulness therapy on the perception and descriptions of daily experiences among depressed individuals.** NATALIA ROHNKA<sup>1</sup>, PAWEŁ HOLAS<sup>2</sup>, IZABELA KREJTZ<sup>1</sup>, JOHN NEZLEK<sup>1</sup> & MARZENA RUSANOWSKA<sup>3</sup>; <sup>1</sup>University of Social Sciences and Humanities, Poland; <sup>2</sup>University of Warsaw, Poland; <sup>3</sup>Jagiellonian University, Poland

The main goal of the study was to examine changes in daily functioning of depressed individuals undergoing Mindfulness Based Cognitive Therapy (MBCT). Participants who met criteria for clinical depression were randomly assigned to either a training group (N=26) or a control group (N=30, a delayed treatment control). They completed an online diary for 7 days before and after the 8-weeks during which the training group received MBCT. At the end of each day, using 7-point scales, participants described the important events that happened to them that day and rated each event in terms of stressfulness, positivity, and how mindful they were during the event. Descriptions of events were analysed with Linguistic Inquiry Word Count (LIWC), a program that provided frequency counts of words in different categories. Multi-level analyses found that after mindfulness training, participants felt more mindful than they did at the pre-test, they perceived events as significantly more positive and less stressful, and they used significantly fewer negation and discrepancy words. There were no significant changes in the control condition for these measures. The results are discussed in terms of two conceptualizations of the treatment of depression – the decrease in cognitive distortions provided by Beck and the decrease in actual-ideal self-discrepancy proposed by Higgins.

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.. (1108) ..

**ERP study of performance monitoring during execution and supervision.** BERTILLE SOMON<sup>1,2</sup>, AURÉLIE CAMPAGNE<sup>2</sup>, ARNAUD DELORME<sup>3,4</sup> & BRUNO BERBERIAN<sup>1</sup>; <sup>1</sup>ONERA The French Aerospace Lab, Salon Cedex Air, France; <sup>2</sup>Univ. Grenoble Alpes, CNRS, LPNC UMR 5105, F-38000 Grenoble, France; <sup>3</sup>Centre de recherche Cerveau & Cognition, Pavillon Baudot, Hopital Purpan, BP-25202, Toulouse, France; <sup>4</sup>Swartz Center for Computational Neurosciences, University of California San Diego, La Jolla, USA

Increase of automation in our everyday-life drastically modified our activities. People who were previously performing tasks, now supervise



them. Performance or error-monitoring is characterized by several Event-Related Potentials (ERPs): ERN, CRN, Pe and FRN. They have been identified and replicated both in error execution and in other agent supervision tasks. In our ERP study we propose to assess whether the neurophysiological correlates of performance monitoring during system supervision are similar to those observed for other agent supervision, and error execution. Participants performed a modified flanker task with feedback. They had to identify the orientation of a vertical arrow going upwards or downwards in the presence or absence of flanking arrows (difficult or easy condition respectively). For each task difficulty three types of task were performed – execution, human agent supervision and system supervision – on 3 separate days. Electroencephalographic data (EEG) was recorded and mean ERPs were identified across participants for each task type and difficulty. Preliminary results show an ERN and FRN at FCz location in the execution task, which peak around 50ms after an error and 250ms after the feedback, respectively. A Pe component observed at Pz location between 200 and 400ms after error execution and between 400 and 600ms after and error detection for both supervision types. No other error-related ERP previously mentioned is observed during supervision. However, we observe another positive wave at FCz peaking at 400ms after error detection for both supervision types. The amplitude of all components is reduced with increasing task difficulty, except for the FRN going oppositely. There is no significant difference in ERP amplitude between supervision of a system and human agent for both difficulties. These results are a first step for the evaluation of the out-of-the-loop (OOL) performance problem, and the degradation of error-monitoring, in more or less complex situation.

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.. (1109) ..

**Rewarding Actions and Their Influence on Intentional Binding.** SAMANTHA ANTUSCH, RUUD CUSTERS & HENK AARTS; *Utrecht University, Netherlands, The*

Operant actions and their subsequent effects are shifted together in temporal perception. This intentional binding effect is assumed to serve the human perception of causality and is consistently used as an implicit measurement of sense of agency. Using monetary rewards, we investigated the influence of varying the nature of the action on intentional binding. It was hypothesized that executing a more rewarding versus a less rewarding action results in stronger binding. In a counterbalanced within-subjects design, participants learned that a key press was more often related to a reward

than an alternative key press while both had the same neutral tone as a result. Confirming the hypothesis, executing an action that was learned to be more rewarding as compared to less rewarding indeed increased tone binding on a subsequent Libet clock task significantly. That is, the results offer important new insights into the underlying working mechanisms of intentional binding and the development of agentic experiences. In detail, intentional binding seems to not solely be influenced by the valence of the action-outcome but also by the nature of the preceding action. Findings are in line with forward models of motor prediction and give rise to a range of empirical questions regarding the importance of action nature and action-outcome valence in the context of temporal binding.

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.. (1110) ..

**Developmental susceptibility to visuospatial illusions across vision and haptics.** CORINNE ASHLEY HOLMES, SARAH MAEVE COONEY & FIONA NEWELL; *Trinity College Dublin*

Developmental studies of susceptibility to visuospatial illusions are limited and inconclusive [1], especially those that contrast perception across multiple sensory modalities [2, 3, 4]. Here, we examine multisensory size perception using two classic visuospatial illusions – the Muller-Lyer and Ebbinghaus illusions – through the individual and combined contributions of vision and haptics (i.e., touch and proprioception). Specifically, we tested 6-10-year-old children and young adults on their ability to estimate size when contextual information was helpful (congruent context), misleading (incongruent context), or absent (no context, the control condition) [1, 5]. Size perception was tested using a 2-AFC paradigm in which two adjacent stimuli were presented simultaneously and, after exploring both, participants indicated the larger of two. In Experiment 1, we examine developmental susceptibility to the Muller-Lyer illusion, and assess the effect of context on size discrimination of one-dimensional lines anchored with convergent versus divergent fins. In Experiment 2, we examine the Ebbinghaus illusion using two-dimensional arrays composed of center circles surrounded by annuli of varying sizes. For both experiments, participants explored the stimuli in one of three conditions: visual only (passive viewing), haptic only (active exploration using hand movements), or bimodal, in which a combination of both inputs could guide perception. Findings from this study are consistent with previous studies suggesting vision and haptics contribute to shape perception in adults [6, 7]. The results from children suggest sensory dominance, and are consistent with previous reports suggesting developmental shifts in

multisensory integration for small scale spatial perception relating to object perception [8], as well as large scale spatial perception for navigation [9]. Importantly, by examining the effect of modality on visuospatial susceptibility across dimensions, these findings will be used to inform mathematical pedagogy – specifically, that related to arithmetic and geometry, when magnitude occupies one and two-dimensional space, respectively.

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.. (1111) ..

**Can action-effect predictions bias perceptual selection?** MYRTHEL DOGGE, RUUD CUSTERS, SURYA GAYET & HENK AARTS; *Utrecht University, Netherlands, The*

Our perception is strongly influenced by the causal origin of sensory input. In particular, self-produced effects are perceived as less intense (sensory attenuation) and reach the threshold of awareness faster (intentional binding), compared to externally produced effects. This differential processing has generally been attributed to motor control processes that we use to anticipate the consequences of our actions. However, it's still unclear to what extent these effects are caused by identity specific predictions (i.e., predictions about which outcome is going to occur) as opposed to the more general prediction that an outcome will follow. In the present study we developed a new paradigm, utilizing onset rivalry, to examine whether specific predictions based on learned action-effect contingencies can bias processing of action outcomes. Participants rotated a knob to trigger a dichoptic rivalry display in which each eye was presented with a different oblique grating that was either congruent or incongruent with learned associations. Contrary to our expectations, the proportion of initially dominant congruent percepts did not reliably differ from chance. This result clashes with general assumptions put forward by forward models and predictive coding accounts of perception.

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## Poster Session I

Top3, Sunday, 18:30 – 21:00

.. (1112) ..

**Size congruity effect extends to vague adjectives: interaction of generalized magnitude representation and language.** ARNOLD KOCHARI<sup>1,2</sup> & HERBERT SCHRIEFERS<sup>2</sup>; <sup>1</sup>*University of Amsterdam, Netherlands*; <sup>2</sup>*Radboud University Nijmegen, Netherlands*

The ability of our cognitive system to represent and compare different magnitudes such as quantity, size, duration etc. has been a focus of a lot

of research. It has been proposed that we make use of a generalized magnitude representation system (GMS). An important question that has not yet been addressed is how GMS interacts with language. In language, we refer to magnitudes using so-called “vague adjectives” such as ‘tall’, ‘long’, ‘wide’, ‘loud’ etc. Interestingly, these adjectives share some properties of the GMS. For example, their applicability as a description of an object is determined by the ratio difference in magnitude between this object and others and they have a fuzzy boundary for when they apply.

In our set of studies, we used the size congruity paradigm with 3 types of stimuli in parallel designs. As a starting point, we replicated the classical number-size congruity effect with digits. Then, we replicated this effect with verbal numbers instead of digits as verbal numbers are more comparable to the vague adjectives. In our critical experiments, participants were presented with pairs of different vague adjectives such as ‘tall-short’, ‘loud-quiet’ etc. Their task was to indicate either the adjective that is written in larger font size (N participants = 22) or the adjective that means ‘more of something’ (N=20, polarity judgment). Like in case with numbers, we manipulated the font size of the adjectives so that it either matched with their polarity (congruent condition) or was in conflict (incongruent). With all 3 types of stimuli, we obtained parallel congruity effects for both tasks as well as interaction of congruity and font size distance in the polarity/numerical task.

We thus find interference of size magnitude and adjective meaning. These results show that we might be routinely using GMS to interpret vague adjectives during language comprehension.

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.. (1113) ..

**Neural representation of lexico-numerical processing in children: An fNIRS study.** MOJTABA SOLTANLOU<sup>1,2,3</sup>, ANDRA COLDEA<sup>4</sup>, CHRISTINA ARTEMENKO<sup>1,5</sup>, THOMAS DRESLER<sup>5,6</sup>, ANDREAS J. FALLGATTER<sup>5,6,7</sup>, ANN-CHRISTINE EHLIS<sup>5,6</sup> & HANS-CHRISTOPH NUERK<sup>1,3,5</sup>; <sup>1</sup>*University of Tuebingen, Tuebingen, Germany*; <sup>2</sup>*Graduate Training Centre of Neuroscience/ IMPRS for Cognitive and Systems Neuroscience, Tuebingen, Germany*; <sup>3</sup>*Leibniz-Institut für Wissensmedien, Tuebingen, Germany*; <sup>4</sup>*Department of Psychology, University of Glasgow, Glasgow, Scotland*; <sup>5</sup>*LEAD Graduate School & Research Network, University of Tuebingen, Tuebingen, Germany*; <sup>6</sup>*Department of Psychiatry and Psychotherapy, University Hospital of Tuebingen, Tuebingen, Germany*; <sup>7</sup>*Center of Integrative Neuroscience, Excellence Cluster, University of Tuebingen, Germany*

Background: The relation between the neural representations of number and letter symbols has not been fully uncovered yet, especially in children.

It is under debate whether the processing of numbers and letters relies on distinct neural substrates or on a mostly shared brain network. Therefore, additional studies are needed to clarify this relationship, particularly in children.

**Method:** In the present study, a total of 47 children from fifth and sixth grades participated in two experiments. During copying number and letter strings, brain activation changes were recorded by means of functional near-infrared spectroscopy (fNIRS) in fifth graders (Experiment 1) and sixth graders (Experiment 2). The task was a written production in a block design.

**Results:** fNIRS data of both experiments revealed that a shared network comprising the fronto-temporo-parietal network is activated in response to both number and letter processing in these ages. No difference was observed in brain activation pattern between these processes in each experiment. The same result was found in a contrast of two processes over all children.

**Discussion:** These findings indicate that in these developing ages copying numbers and letters relies on mostly similar brain networks. However, task-specific activation of magnitude and lexical processing might be confounded by strong unrelated activation during both tasks, such as sensory-motor activation of responses and visual attention, which is a question for future research. The findings are discussed in relation to their theoretical and practical implications.

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.. (1114) ..

**Intra-Subject Variability in Mathematical Learning Difficulties.** SHARON LEVY & LIAT GOLD-FARB; *University of Haifa, Israel*

Difficulties in performing simple arithmetic tasks and procedures are characteristic of mathematical learning difficulties (MLD). However, several findings suggest that MLD is also related to attention deficits. While some suggest that it relates to general attention difficulties, others suggest that people with MLD have attentional deficits that are specific to the arithmetic domain. The difficulties characterizing people with MLD have usually been investigated by analyzing level of accuracy or central measurements such as mean response times (RT). Little consideration has been given to measures of intra-subject variability (ISV). These measures have unique importance since they provide information about the consistency and efficacy of individuals' cognitive system.

The current study thoroughly examines the consistency of arithmetic performance as manifested by ISV measures in people with MLD. Participants were adults with MLD and a matched control group without learning difficulties who performed

a variety of numerical and non-numerical tasks. Results show that the MLD group had higher ISV measures compared to controls only when performing numerical tasks. It appears that in addition to the numerical deficits characterizing this population, they also have difficulties recruiting attentional resources when performing simple arithmetic tasks, leading to inefficient and fluctuant performance. These findings can help better understand mathematical learning difficulties and develop new interventional programs for improving the arithmetic performance of this population.

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.. (1115) ..

**Cognitive Control across Domains: Conflict Adaptation from Magnitude to Arithmetic Processing.** GLORIA TEJERO<sup>1,2</sup>, CRISTINA SEGURA<sup>1,2</sup> & PEDRO MACIZO<sup>1,2</sup>; <sup>1</sup>*University of Granada, Spain*; <sup>2</sup>*Mind, Brain and Behavior Research Center (CIMCYC, Spain)*

The solving of addition problems is sometimes conflicting. When individuals receive an addition and they have to indicate that the proposed result is incorrect (e.g.,  $2 + 4 = 8$ ), the activation of the multiplication counterpart interferes (associative confusion effect). This interference seems to be resolved by the use of an inhibitory mechanism in charge of suppressing activation of the irrelevant result (8). Thus, it is difficult to verify an addition afterwards, when the inhibited result is presented again (e.g.,  $3 + 5 = 8$ ). The goal of the current study was to determine whether cognitive control, which is used to resolve conflict in arithmetic processing, is an example of a general control mechanism acting when conflict occurs in other fields (e.g., the retrieval of magnitude information). To this end, we considered conflict adaptation between magnitude and arithmetic tasks. Our participants performed two consecutive tasks. In two trials, a number comparison task was used where two digits varying in size were presented and the number with larger numerical value had to be selected. To examine numerical Stroop effects, the size and magnitude of these two numbers were congruent (3 8) or incongruent (3 8). After these two trials, participants received an addition and they had to decide whether it was correct or not. This addition was presented with the result of multiplying the operands ( $2 + 4 = 8$ , conflict) or not ( $2 + 4 = 10$ , non-conflict). The results showed numerical Stroop and associative confusion effects. Importantly, there was conflict adaptation (reduced interference after conflict vs. non-conflict trials) within the two trials of the number comparison task and between the last trial of the number comparison task and the first trial of the addition verification task. This pattern of results suggests the existence of a control mechanism

acting across domains, at least between magnitude processing and simple arithmetic.

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.. (1116) ..

**Not all university students know how much is 9 times 3.** JASINTA D. M. DEWI<sup>1</sup>, CAROLINE CASTEL<sup>2</sup> & CATHERINE THEVENOT<sup>1</sup>; <sup>1</sup>*University of Lausanne, Switzerland*; <sup>2</sup>*University of Geneva, Switzerland*

In order to study the strategies used by university students when they solve multiplication problems, we used the operation-recognition paradigm, which we developed to overcome the potential biases associated with verbal reports. This paradigm capitalizes on the fact that after an algorithmic procedure, the operands are necessarily decomposed and their memory traces are degraded in working memory. Therefore, comparing recognition times of the operands after they have been involved in a multiplication or a comparison, which does not imply any decomposition of numbers, allows us to infer the strategy used by participants. If recognition times of the operands are longer after a multiplication than a comparison, we conclude that an algorithmic procedure has been used for the multiplication. Our results show that when the task involves small numbers with a sum up to 10, recognition times of the operands after a multiplication and a comparison are not significantly different. Therefore, in this case, the paradigm cannot detect the use of algorithmic procedures. Nevertheless, when the task involves larger numbers with a sum superior to 10, recognition times are slower after a multiplication than after a comparison task. In this case, we can firmly conclude that an algorithmic procedure was used by some of our participants to solve multiplication problems. In fact, this conclusion held true for nearly half of our sample with the lowest arithmetic skills. Our results show that, contrary to the commonly accepted view, educated adults do not always retrieve the results of multiplication problems from long-term memory and that the conclusions of past studies based on this assumption might need to be revised.

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.. (1117) ..

**Comparison of mental rotation training effects depending on the initial level of spatial skills in preschoolers.** LAURA MARÍA FERNÁNDEZ-MÉNDEZ, MARÍA ROSA ELOSÚA & MARÍA JOSÉ CONTRERAS; *Universidad Nacional de Educación a Distancia, Spain*

**Background.** The strong relationship between STEM disciplines (Science, Technology, Engineering and Mathematics) and Mental Rotation (MR)

has resulted in an increasing interest in knowing the age at which it is developed, and in its possibilities of improvement. Several studies have shown the effectivity of MR training, as well as a greater improvement in participants with a lower initial ability. However, studies focusing on Preschool children are still very scarce. The present work aims to analyze the effectiveness of MR training, comparing the effect in children with high and low initial spatial ability in 1st and 3rd year of Preschool Education.

**Method.** A total of 58 1st year Preschoolers and 60 3rd year. Preschoolers took part, of which 29 and 30 children, respectively, performed a MR training with different angular disparities.

**Results.** A significant improvement in MR of the training group with respect to the control group was found for both courses, with a slightly higher effect size in 3rd year Preschoolers. With regard to training benefit, only 3rd year Preschoolers with lower initial ability showed a statistically significant improvement in comparison with those with higher initial spatial ability.

**Discussion.** Both age groups showed MR enhancement after training, proving that it is not only possible for children in these age groups to perform MR processes, but it is also possible to promote them. Furthermore, the differential improvement in favor of children with lower initial spatial ability in the older group shows that from such an early stage, those less skilled can be reinforced to improve their spatial abilities.

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.. (1118) ..

**The ways to become less afraid of math: exploring cognitive interventions for math anxiety within the school system.** NOAM BIALIK; *The Edmond J. Safra Brain Research Center for the Study of Learning Disabilities, University of Haifa, Israel*

Math anxiety is defined as a person's negative affective reaction to situations involving numbers, math and mathematic calculations. It has profound effect on daily life and career choices, causing the anxious individuals to actively avoid situations involving mathematics and immediately fail while encountering math problems and math tests, regardless of their actual mathematical abilities. It can appear at any point throughout the life span, often being directly connected to the individual's experience in math classes within the school system.

Due to this, and to the fact that math anxiety shares many cognitive and physiological aspects with general anxiety, the current study examines two cognitive ways of intervention known to be effective in general anxiety on math anxiety and math performance. These interventions will take place within the school system itself, can be easily ap-

plied by teachers, and will be conducted in 2nd, 5th, and 8th grades, thus lending the opportunity to examine their efficiency from a developmental perspective. Interventions will include: 1) studying the fight or flight system and understanding that it can actually help us remain alert in frightening situations, thus giving the students ability to reappraise their physiological symptoms of threat as positive facilitators; 2) studying the notion of brain plasticity and teaching the students that their brains grow and change with learning, thus helping them understand that no ability is "fixed" and they can actually improve in any field. Math performance, math anxiety and other cognitive and affective measures will be assessed before and after the interventions. Initial results of the study appear promising. Email: noam.saragossi@gmail.com

.. (1119) ..

**Symbolic processing mediates the relationship between nonsymbolic processing and later arithmetic performance.** SABRINA FINKE, H. HARALD FREUDENTHALER & KARIN LANDERL; *University of Graz, Austria*

The nature of the relation between nonsymbolic and symbolic magnitude processing in the prediction of arithmetic remains a hotly debated subject. This study examined whether the influence of nonsymbolic magnitude processing on future arithmetic is mediated by symbolic processing skills. The sample consisted of 131 children participating in a study on the developmental trajectories of basic numerical skills in children with typical and atypical arithmetic development (Landerl, 2013). The children were followed from the beginning of second grade (mean age 7; 6 years) through the beginning of fourth grade. In order to assess nonsymbolic processing skills, we employed a computerized magnitude comparison task with set sizes ranging from 20 to 84. Children were asked to select the display with the larger number of squares. Demands on inhibitory control were carefully controlled for by ensuring that the total surface area covered by the squares remained the same on both displays. Symbolic comparison skills were measured by two different tasks, namely i) comparison of single digit numbers and ii) comparison of two digit numbers. Both measures of symbolic processing mediated the influence of nonsymbolic processing on later arithmetic. These results support the view that symbolic processing plays an important role in the development of arithmetic during primary school and might be a valuable long-term indicator when aiming to identify children at risk for low achievement in arithmetic.

Reference:

Landerl, K. (2013). Development of numerical processing in children with typical and dyscalculic

arithmetic skills—a longitudinal study. *Frontiers in Psychology*, 4, 459. doi:10.3389/fpsyg.2013.00459  
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## Poster Session I S17, Sunday, 18:30 – 21:00

.. (1701) ..

**„To eat or not to eat...“ – relationship between executive functions and body mass index.** JULIANNA BIRCHER<sup>1,2</sup>, ESZTER KOTYUK<sup>3,2</sup>, RENATA CSERJESI<sup>2</sup> & ANNA SZEKELY<sup>2</sup>; <sup>1</sup>*Doctoral School of Psychology, Eötvös Loránd University, Budapest, Hungary;* <sup>2</sup>*Institute of Psychology, Eötvös Loránd University, Budapest, Hungary;* <sup>3</sup>*Postdoctoral Research Program, Hungarian Academy of Sciences, Hungary*

Similarly to addiction, reward system and executive functions are key factors in body mass control. According to recent studies (Cserjési et. al, 2009; Fagundo et al., 2012) female participants with either anorexia nervosa or obesity showed worse performance in executive function tasks as compared to healthy eating controls. Based on these results, we hypothesized that subjects outside the normal interval of body mass index give slower responses and make more errors in the Stroop task as compared to healthy controls.

152 healthy Caucasian subjects (54.6 % males, age: 18-71 with the mean of 30.84 years) participated in the study. We collected data about demography, height and weight. 11 underweight (mean BMI: 17.9), 98 normal weight (mean BMI: 21.8), and 43 overweight (mean BMI: 28.9) subjects solved the computerized Stroop task (Spieler, Balota & Faust, 1996) where we measured reaction time and error number through 72 (congruent and incongruent) trials.

Results showed that subjects with normal BMI made less errors ( $p=0.033$ ), particularly in incongruent trials ( $p=0.022$ ) as compared to under- and overweight subjects. This difference was more explicit in incongruent versus congruent trials, interaction of BMI and type of stimuli was significant ( $p=0.045$ ).

Our results are in line with the literature suggesting that in cognitive task when inhibition control functions are necessary under- and overweight subjects perform worse as compared to normal weight participants. However, in our sample there were no pathological overweight (obese) or underweight (anorexic) subjects. In the future we need to examine a larger sample with longitudinal method, and with exact data about body composition. (e. g. body fat).

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.. (1702) ..

**Lateral asymmetry in the peripheral processing of musical stimuli.** KRISZTIAN KASOS<sup>1</sup>, AV-RAHAM LIFSHTITZ<sup>2</sup>, SZABOLCS ZIMONYI<sup>2</sup>, ZOLTAN KEKECS<sup>3</sup>, KATALIN VARGA<sup>2</sup> & ANNA SZEKELY<sup>2</sup>;  
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Music has the ability to express basic emotions which can be distinguished accurately even without musical training (Thompson & Robitaille, 1992; Juslin, 1997). These emotions elicit different levels of arousal measured by electrodermal activity (EDA) (Khalfa, 2002). The purpose of the present study was to test whether basic emotions conveyed by short musical excerpts would elicit lateralized EDA responses. According to our hypothesis, EDA activity elicited by negative and positive emotions would show different lateralization.

University students (N=63) were exposed to 28 short musical segments in a random counterbalanced order. The interstimulus interval was set to 1 minute, during which participants were asked to rate the musical segments on their intensity, valance and clarity. The 7 second excerpts used in this study were shown to successfully convey the intended emotions which were fear, sadness, happiness and peacefulness (Khalfa, 2002).

Analysis of the electrodermal responses was performed in Ledalab 3.4.8 (Benedek & Kaernbach, 2010) and statistical analysis was completed in SPSS 22. Lateralized responses to the musical segments were confirmed, more specifically negative emotions (fear and sadness) evoked stronger responses on the right side, whereas arousal was more explicit on the left side for positive emotions (happiness and peacefulness)  $p=.007$ . Analyzing all four emotional stimuli resulted in a significant effect ( $p=.023$ ), the most lateralized response was elicited by sadness.

These results highlight the unique lateral changes in EDA brought about by short musical excerpt and lend further support to the predictions of Multiple Arousal Theory (Picard, 2015). Since emotions do not map the same arousal on both sides of the body, bilateral measurement of EDA could prove fruitful in future research.

This work was supported by ELTE-PPK, funding our PhD consortium.  
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.. (1703) ..

**Assessing the processes underlying mindfulness training.** LENA WIMMER, SILJA BELLINGRATH & LISA VON STOCKHAUSEN; *University of Duisburg-Essen, Germany*

Mindfulness is defined as a state of non-judgmental, accepting awareness of moment-by-moment experience. Current psychological models of mindfulness posit attention regulation as the core of this state (cf. Malinowski, 2013) and accordingly attribute positive effects of mindfulness training to improved skills in attention regulation. The present study investigated cognitive effects of mindfulness practice (in an adapted version of the Mindfulness Based Stress Reduction method, Kabat-Zinn, 1990, with meditation and bodyscan as core practice; N=104) in comparison with a phenomenological and informal awareness training as active control group that did not follow a systematic schedule (following Blackmore, 2010; N=45) and a passive control group with no training (N=31). Furthermore, mindfulness was practiced including (N=60) or excluding yoga poses (N=44). Following Bishop et al.'s (2004) model of mindfulness, cognitive functions were assessed in terms of sustained attention, cognitive flexibility, cognitive inhibition and data-driven information processing, in a pre-post design with student participants enrolled in university classes. Only systematic training of attention as in meditation and bodyscan was expected to improve cognitive functions. Following this line of reasoning, including yoga was not expected to have incremental effects beyond meditation and bodyscan. Linear mixed-effects models revealed specific benefits of mindfulness training regarding sustained attention and data-driven information processing. While both mindfulness trainings were equally effective in promoting sustained attention, training without yoga even tended to be superior to training including yoga concerning data-driven information processing. Moderation analyses showed that results were not affected by practice time. Results confirm our prediction that improving cognitive functions requires systematic attention training as provided in meditation and bodyscan. The study contributes to clarifying the processes, which underlie mindfulness training, and confirms the central role of attention regulation. It also provides an approach to identify effective ingredients of training based on hypothesized underlying processes and specified outcomes.

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.. (1704) ..

**Effects of the cognitive cost and the duration of interruptions: a behavioral study paired with eye-tracking measures.** CYRIL COUFFE<sup>1,2</sup>, SARA SALGUES<sup>1</sup>, MARIA MUTIS<sup>1</sup> & GEORGE A. MICHAEL<sup>1</sup>; <sup>1</sup>Laboratoire d'Etude des Mécanismes Cognitifs, Université Lyon 2; <sup>2</sup>Grenoble Ecole de Management

Background: Being interrupted causes the processes of the main task to be stopped and their activation to decline over time. According to Barrouillet et al. (2009), during the interruption task, maintenance mechanisms might help preserving this activation. They predict that these mechanisms' efficiency might be impaired when (i) the cognitive cost of interruptions is high; (ii) when interruptions are long to complete. However, these effects were never directly demonstrated using an interruption task.

Method:

Participants: 34 volunteers (age  $21.8 \pm 1.5$  years)

Main task: in an email box environment, participants selected target-emails between distractors as quickly and accurately as possible. Each target was defined by 3 criteria presented in an area of interest at the top of the page.

Interrupt Task: sets of numbers varying in length were presented (one digit per second). Participants had to recall the last 3 digits but could not predict the length of each series. Interruptions differed in cognitive cost (low vs high) and durations (short: 25.8s vs long: 38.5s)

Procedure: Participants began the main task and were interrupted in 4 out of 5 trials. The Main Task Completion Times (MTCT) and Return to Main Task Times (RMTT) were recorded. The Times spent on the Area of Interest (TAI) were extracted from eye-recording data.

Results:

MTCT were longer in interrupted conditions (mean: 26.2s) than in the uninterrupted condition (24.9s).

RMTT varied with cognitive cost (low: 6.2s, high: 6.8s) and duration (short: 6.3s, long: 6.7s).

TAI were the longest after low cognitive cost/longer interruptions (5.49s). No difference was observed between the other conditions (4.7, 4.6, and 5s).

Discussion:

These behavioral results suggest that high cognitive cost and longer durations cause longer returns to the main task. Also, eye-tracking measures suggest the use of different strategies when reacting to interruptions of varying durations.

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.. (1705) ..

**Target Color and Contrast Influences Temporal Attention in Rapid Serial Visual Presentation Tasks.** AYTAC KARABAY & ELKAN G. AKYUREK; *University of Groningen, Netherlands*

Attentional blink (AB) is a phenomenon that identifying the second target (T2) stimulus is restricted when it follows the first target (T1) with a short interval (200-500 ms). Various factors modulate AB; in this study, we investigated how target (I) colors and (II) contrast influence temporal attention. Attentional blink/temporal integration task was adapted to study in order to test how different color/contrast pairs influence T2| T1 accuracy and temporal integration. There were two color/contrast conditions: single color/contrast (T1 and T2 colors/contrast matched), mixed color/contrast (T1 and T2 were different colors/contrast). (I) It is found that T2| T1 accuracy were higher in single color condition. Further color specific analysis showed that T1 and T2 accuracy was high when target color was red and T2| T1 identification was greater when T2 color was red. Moreover, greater integration was observed in mixed color condition. It is a surprising finding since targets did not contain multiple colors in any trials. (II) There was no difference between single and mixed contrast condition on T2| T1 accuracy and temporal integration. Greater T1 and T2 accuracy was observed when targets were in high contrast condition. Better T2| T1 identification was observed in the high contrast T2 condition. On the contrary, integration was affected by T2 contrast, and more integration was observed when T2 contrast was low. In conclusion, (I) temporal attention was influenced by target color-pair conditions; however (II) contrast condition does not influence temporal attention in the same way color-pairs does.

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.. (1706) ..

**Temporal task demands and attentional capture by rewarded distractors.** JÉRÉMY MATIAS<sup>1</sup>, JEAN-CHARLES QUINTON<sup>2</sup>, MICHÈLE COLOMB<sup>3</sup>, MARIE IZAUTE<sup>1</sup> & LAETITIA SILVERT<sup>1</sup>; <sup>1</sup>Laboratoire de Psychologie Sociale et Cognitive, France; <sup>2</sup>Laboratoire Jean Kuntzmann, France; <sup>3</sup>CEREMA, France

The capacity to focus our attention on task-relevant stimuli is critical to maintain a good level of performance. Nevertheless, irrelevant but visually salient stimuli can easily capture our attention and divert us from the task at hand. Similarly, reward-related stimuli have high attentional priority regardless of their physical salience or task-relevance. It has been proposed that our ability to avoid distraction by salient stimuli could be influenced by the time constraints of the task: we would need to set more stringent attentional filters when

temporal demands are high to avoid useless distraction and maintain a satisfying level of performance. Thus, the aim of the present study was to investigate the influence of temporal demands on the distraction produced by reward-associated distractors. The participants performed a visual search task for a black moving target among black static distractors. On some trials, one of those distractors turned into a highly salient colored distractor. In a first study, colored distractors were not associated with reward outcomes whereas they signaled a high or low reward outcome in the second study. In each study, the stimuli were displayed until response for half of the participants (no time pressure), and during 200 ms for the other half (time pressure). Results show that time pressure increases distraction by salient non-reward stimuli, but has no significant effect on distraction produced by salient reward-associated stimuli. Nevertheless, the distraction effect is modulated by the distractor's value (high or low reward). Our results will be discussed within the scope of the Load Theory (Lavie, 2010).

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.. (1707) ..

**Consequence of residual effects of Zolpidem on cognitive performance at high altitude.** KAREN DAVRANCHE<sup>1</sup>, LAURENCE CASINI<sup>2</sup>, GUILLAUME SÉCHAUD<sup>3,4,5</sup>, PIERLUIGI BANCO<sup>3,4,5</sup>, SÉBASTIEN BAILLIEUL<sup>3,4</sup>, PAUL ROBACH<sup>3,4,6</sup>, PIERRE BOUZAT<sup>7,5</sup> & SAMUEL VERGES<sup>3,4</sup>; <sup>1</sup>UMR 7290, CNRS & Aix-Marseille University, France; <sup>2</sup>UMR 7291, CNRS & Aix-Marseille University, France; <sup>3</sup>HP2 Laboratory, Grenoble Alpes Université, Grenoble, France; <sup>4</sup>U1042, INSERM, Grenoble, France; <sup>5</sup>Pôle Anesthésie Réanimation, CHU de Grenoble, Grenoble, France; <sup>6</sup>National school for mountain sports (ENSM), Chamonix, France; <sup>7</sup>Grenoble Institute of Neurosciences, INSERM U836, Grenoble, France

Background: Robach et al. (2016) recently showed that 35.8% of alpinists attempting to ascend Mont-Blanc consume at least one drug. The hypnotic Zolpidem is used by 8.4% of climbers to reduce sleep disturbances the night before the ascent. The present study aimed to assess residual effects of 10mg Zolpidem (dose recommended by the manufacturer) on cognitive processes after a 3-hours night sleep in normoxia (240m altitude) and in hypoxia (3842m altitude), i.e. mimicking the typical timing of an ascent to Mont-Blanc.

Method: The subjects (n=22) received Zolpidem or placebo orally in random order using a double-blind, cross-over design. The medication was administered just before the scheduled bedtime at 22:00. At 01:00, subjects were awakened and at 02:00 they were required to perform two cognitive tasks, a conflict task and a temporal bisection task,

at rest and while cycling at 50% of their maximal aerobic power.

Results: Results have suggested that Zolpidem impacted information processing in terms of both speed and number of errors in the conflict task. In addition, the error distributions analysis has shown that Zolpidem impacted the entire distribution, which suggests an increase in subject's sensitivity to irrelevant information. Moreover, both the variability of reaction times in the conflict task and the variability of temporal judgements increased under Zolpidem compared to placebo, evoking a deficit in attention.

Discussion: Despite improving sleep quality in climbers, the residual effects of the hypnotic impaired cognitive performance. Zolpidem has lengthened reaction time, has increased the number of errors, has affected cognitive control and has induced attentional deficit. All these factors may increase the risk of accidents in an unpredictable environment such as mountains and would reduce reactivity in potential emergencies.

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.. (1708) ..

**CHAP: An Open Source Software for Processing and Analyzing Pupillometry Data.** RONEN HERSHMAN<sup>1,2</sup>, NOGA COHEN<sup>3</sup> & AVISHAI HENIK<sup>2,4</sup>; <sup>1</sup>Department of Cognitive and Brain Sciences, Ben-Gurion University of the Negev, Beer-Sheva, Israel; <sup>2</sup>Zlotowski Center for Neuroscience, Ben-Gurion University of the Negev, Beer-Sheva, Israel; <sup>3</sup>Department of Psychology, Columbia University, New York, USA; <sup>4</sup>Department of Psychology, Ben-Gurion University of the Negev, Beer-Sheva, Israel

Pupil dilation is an effective indicator of cognitive load. There are many available eye tracker systems in the market that provide effective solutions for pupil dilation measurement, which can be used to assess different cognitive and affective processes. However, there is a lack of tools for processing and analyzing the data provided by these systems. For this reason, we developed CHAP - an open source software written in Matlab. This software provides a user-friendly interface (graphical user interface) for processing and analyzing pupillometry data. The software receives input of a standard output file from the Eyelink (EDF file) and the Eyetribe (CSV file) eye trackers and provides both pre-processing and initial analysis of the data. Our software creates uniform conventions for building and analyzing pupillometry experiments, and provides a quick and easy-to-implement solution for researchers interested in pupillometry.

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.. (1709) ..

**Visual distinguishability of confusing Chinese and Japanese character pairs in disturbed text alignments.** AKIRA ASANO<sup>1</sup>, SHIN YAMAMOTO<sup>1</sup>, CHIE MURAKI ASANO<sup>2</sup>, KATSUNORI OKAJIMA<sup>3</sup>, MIKIKO KAWASUMI<sup>4</sup>, LIANG LI<sup>5</sup> & XIAOYING GUO<sup>6</sup>; <sup>1</sup>Kansai University, Japan; <sup>2</sup>Nagoya Women's University, Japan; <sup>3</sup>Yokohama National University, Japan; <sup>4</sup>Meijo University, Japan; <sup>5</sup>Ritsumeikan University, Japan; <sup>6</sup>Shanxi University, China

We investigate the influences of text alignments to human distinguishability of confusing character pairs. We performed experiments of measuring response time for finding a character in an arrangement of a slightly different and confusing character.

Respondents were presented with a character arrangement that was composed of one repeated character and only one slightly different character located at a random position in the arrangement on a computer screen. The respondents were requested to point out the different character as soon as possible. The elapsed time between the appearance of the arrangement and pointing by the respondent was measured.

We employed the following conditions of arrangements: (1) Characters are straightly aligned vertically and horizontally. (2) The starting positions of lines are randomly disturbed, but the character spacing is constant. (3) The starting positions and the ending positions of lines are straightly aligned, but the character spacing is randomly disturbed. We employed three different pairs: Chinese characters and two kinds of Japanese phonograms, hiragana and katakana. All the 86 respondents were familiar with these characters.

We focus on intrapersonal time differences for different arrangements. The results show that the time consumption in (2) is significantly larger than (1) and (3) in the cases of hiragana and katakana characters, and marginally significantly larger for Chinese characters. The results indicate that disturbance on starting positions of lines has more influence on human distinguishability than that on character spacing. It is known that the experienced readers expect that every line starts at the same horizontal position. The results suggest that the respondents employed the same strategy as reading texts in the task of finding a randomly located character. The results also suggest that the influence is more significant in the case of hiragana and katakana, which have rather simpler appearances, than for more complex Chinese characters.

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.. (1710) ..

**Testing perceptual load theory in the tactile domain.** SANDRA MURPHY & POLLY DALTON; *Royal Holloway, University of London, United Kingdom*

Perceptual load theory suggests that the level of perceptual load in a relevant task determines the extent to which irrelevant information is perceived (e.g. Lavie, 2010). While the majority of evidence from the visual domain supports the theory, mixed findings exist within the auditory domain (e.g. Murphy et al., 2017), raising the question of whether the principles of the theory can be applied to sensory modalities other than vision. We sought to investigate this question within the tactile domain. Across two experiments, we delivered a tactile stimulus to participants' hands, which consisted of a constant or pulsed vibration presented with low or high intensity. In the low load condition, participants reported whether the target was constant or pulsed, whereas under high load participants responded according to a conjunction of vibration type and intensity. A brief tap was presented to the participant's forehead on half of the trials, at the same time as the target presentation. After each target response, participants reported the presence or absence of this stimulus. In Experiment 2, we also assessed participants' metacognitive abilities regarding the presence or absence of the additional stimulus by asking them to rate their confidence on every trial. Across both experiments, participants' sensitivity to the additional stimulus on the forehead was significantly reduced under high (vs. low) perceptual load. However, there was no difference in participants' metacognitive ratings as a function of load. These findings are some of the first to suggest that perceptual load theory can be extended to the tactile domain.

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.. (1711) ..

**How can we handle interruptions of an email searching task ?** PAUL BRAZZOLOTTO & GEORGE MICHAEL; *Laboratoire EMC, France*

In everyday life and especially at work, we must deal with recurring interruptions. Although many researchers studied interruptions and how detrimental they can be for performance, a small number of studies detected with success those cognitive processes involved in resuming the primary task after an interruption. Thus, we carried out three experiments to comprehend how these processes work, by manipulating factors requiring different cognitive functions (i.e. working memory, inhibition) and assessing the involvement of specific processes through neuropsychological tests. We used an ecological primary task of email searching during which participants could be interrupted by a working memory task.

In all experiments, we manipulated the complexity and the moment of interruption which are supposed to influence the time to resume the primary task (i.e. RL). The results showed that with a

simple interruption, the RL was slower for a small number of actions than for a greater one, and that there was no difference for complex interruptions. Our results indicate a difference in RL between the two factors. In experiments 2 and 3, participants completed the same task and, in addition, several neuropsychological tests. Principal component analyses carried out with the RL and scores obtained in the neuropsychological tests showed that the complexity was related to inhibition, shifting, selective attention and automation, and that the effects of moment were related to working memory, planning and divided attention.

These results reveal that many functions are needed at different degrees to resume the primary task after the interruption, and that complexity and moment require selectively one or several of them.  
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.. (1712) ..

**Effects of cognitive ageing on landmark detection and recognition - an eye-tracking study.** RAMONA GRZESCHIK<sup>1</sup>, RUTH CONROY DALTON<sup>2</sup>, ANTHEA INNES<sup>3</sup> & JAN WIENER<sup>1</sup>; <sup>1</sup>Bournemouth University, United Kingdom; <sup>2</sup>Northumbria University, United Kingdom; <sup>3</sup>University of Salford, United Kingdom

Landmark recognition is essential for route learning. However, not every object is a useful landmark, be it due to repetitive occurrence or visual appearance. Salient objects (e.g. fire extinguishers) catching attention might be easier to memorize than non-salient objects, but if they appear more than once along a route (=“non-unique”), they can’t be used as reliable landmarks. Cognitive ageing affects executive functions and control of attention which could impact on choosing relevant objects as landmarks and therefore route memory. The aim of the presented study was to investigate how cognitive ageing affects people’s ability to select unique objects as landmarks for place and route learning and how deficits in landmark selection might affect the navigation skills of older participants. To do so, participants were navigated passively through a virtual care home on short routes, each comprising four intersections each with two objects, of which some appeared twice on that route (=“non-unique”). Learning performance and gaze behavior was recorded from young and old participants. The behavioral data showed that younger participants outperformed the older participants on learning the routes. The eye-movement data revealed a smaller saccade amplitude and lower saccade frequency for older participants compared to young participants. Further, saccade amplitude and frequency were reduced for incorrect responses compared to correct responses in both age groups. These results suggest an effect of cognitive ageing on the control of visual

attention which, in turn, contributes to age-related deficits in route learning performance.

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.. (1713) ..

**Temporal and spatial characteristics of dynamic visual search in periodically masked displays.** DOUG BARRETT<sup>1</sup> & MICHAEL PILLING<sup>2</sup>; <sup>1</sup>University of Leicester, United Kingdom; <sup>2</sup>Oxford Brookes University, United Kingdom

Visual search entails the comparison of perceptual objects with a target-template held in visual working memory (VWM). When the temporal continuity of objects in the scene is disrupted or masked, VWM may also support the integration of information during visual sampling. The current study investigates the impact of temporal discontinuity on the speed and accuracy of search. Observers searched for a Landholt C at a cued orientation among randomly oriented Cs in displays containing two, four or six objects. Objects were masked by dynamic visual noise and mask opacity varied between 1 (opaque) and 0 (transparent) during each trial. Experiment 1 compared search speed and accuracy for masks modulated by a logistic and sinusoidal functions with periods of 400, 200 and 100 milliseconds. Experiment 2 compared search speed and accuracy for objects masked synchronously and asynchronously by sinusoidal functions with periods of 400 and 200 milliseconds. Experiment 1 revealed a slowing of RTs for objects masked by sinusoidal compared to the logistic function at set sizes of 2 and 4. At set size 6, RTs were comparable across modulation type, although accuracy decreased for displays masked by the logistic compared to sinusoidal functions. In Experiment 2, RTs were reduced for asynchronous compared to synchronously masked objects modulated at 2.5 but not 5 Hz. This asymmetry was most apparent at set size 6. The results are consistent with a small reduction in the rate of search when the temporal continuity of objects is disrupted. Changes in accuracy were restricted to set sizes of 6, suggesting observers’ ability to integrate information across temporal discontinuities is sensitive to changes in the spatial distribution of attention in synchronously and asynchronously masked displays.

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.. (1714) ..

**Cognitive control demands in self-organized multitasking: The costs of a flexible switching strategy.** JOVITA BRÜNING & DIETRICH MANZEY; Technische Universität Berlin, Germany

Recently, Reissland and Manzey (2016) provided evidence that individuals prefer one of three distinct task organization strategies in the context

of multitasking. Individuals either used a blocking, a switching or a response grouping strategy to perform a concurrent dual-task, requiring the participants to perform two threads of discrete, simple classification tasks simultaneously. Remarkably, the 'switchers' showed considerable evidence for overlapping processing at task switches while multitasking, indicated by very fast switch times without compensatory increments of response times in pre-switch trials.

In the current study, we investigated whether similar individual differences can still be found for concurrent dual-tasks with a higher level of task complexity and working-memory involvement. The used dual task involved a classification task requiring a comparison of two stimuli and a Sternberg memory-search task. Indeed, all three task organization strategies were found again. Moreover, 'switchers' again showed a considerable amount of overlapping processing, even under increased working memory load. However, in this case, they also showed significant mixing costs, which were not observed in the previous study (Reissland & Manzey, 2016). Remarkably, these costs occurred in repetition trials before both, extreme fast switch responses and switch trials with usual switch times. Thus, they do not reflect a trade-off of processing times before and after switches. Instead they seem to reflect extra time effort for an online task-organization and response scheduling while multitasking, which are not apparent with less (memory) demanding tasks. However, preliminary data of a currently conducted experiment (n=33) using only more complex classification tasks, but no explicit working memory tasks, again replicates the finding of increased mixing costs for the switcher task organization strategy. This suggests that already a moderate increase of working memory demands by using more complex classification rules is enough to compromise the efficiency of an otherwise efficient multitasking strategy.

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groups, prospective memory has received little attention in relation to intellectual disability. A prospective part (when to act/timing) and a retrospective part of prospective memory (what to do/plan) are identified. Retrospective memory and vigilance are important for execution in prospective memory in persons with intellectual disability.

Method:

A group with intellectual disability (IQ < 70, n=58) was defined together with a control group matched on age, sex, level of education and years of education (n=116) in the Swedish Betula database.

Results:

Prospective memory performance was lower in the intellectual disability than the control group. About half of the participants with intellectual disability remembered the retrospective part of the prospective memory task if the experimenter provided a cue. Persons with intellectual disability were able to perform on the prospective memory task, despite performance at floor level for verbal prospective memory tasks in previous studies.

Episodic memory was related to recognition, recall and semantic memory in both groups. Contrary to previous results, prospective memory correlated with episodic memory, semantic memory, short-term memory, recall, recognition, and knowledge only in the control group.

Discussion:

Persons with intellectual disability remembered the retrospective aspect of the prospective memory task despite lower performance than the control group on other memory tasks. The intellectual disability group performed lower than the control group although performance preceded the ongoing task. Finishing all tasks may have formed a context to associate with prospective memory performance in particular for the control group with a higher memory capacity to engage in memory processing compared to the intellectual disability group. We suggest matching on education as a reason for this result.

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.. (1802) ..

**Examining the transformation of stored spatial relations in children and adults.** CHRISTOS MICHAELIDES & MARIOS AVRAAMIDES; *University of Cyprus, Cyprus*

Our everyday functioning requires the ability not only to form and maintain in memory stable representations containing spatial relations, but also to transform them. The goal of the present study was to assess the ability of children at various ages (7-9-11-year olds) and adults to (1) form accurate spatial representations for layouts containing multiple objects, and (2) apply transformations on these memorized representations, in order to

## Poster Session I

**S18, Sunday, 18:30 – 21:00**

.. (1801) ..

**Prospective memory and intellectual disability.** ANNA LEVÉN; *Linköping University, Swedish Institute for Disability Research, Sweden*

Background:

Persons with intellectual disability often omit acting on intentions in the future, e.g., to take medicine at lunch. Despite research in different clinical

characterize the developmental trajectory of this ability. Participants studied an array of 4 objects placed at predetermined locations on the circumference of a circle. Once they memorized the array, in the direct retrieval phase, they were asked to recreate it by placing the location of each object on a handout containing a printed circle. Subsequently, in the transformation phase, they were asked to place one of the objects at a random position on the circumference of the circle and then, insert the remaining 3 objects at locations around the circle so that the spatial relations from the memorized array were preserved. By comparing location accuracy for the direct retrieval and the transformation phase across age groups, we were able to assess the developmental trajectory of forming accurate mental representations for multi-object layouts and of efficiently applying angular transformations to memorized locations. Results from the direct retrieval task showed that 7-year olds were less accurate than older children and adults, while 9 and 11-year olds showed comparable performance to each other and to adults. Results from the transformation task revealed that adults were more accurate than children, and that 11-year olds were more accurate than 7-year olds. Overall, these findings suggest that the ability to apply spatial transformations on memorized representations (1) develops gradually during childhood, and (2) has a steeper developmental slope than the simple retrieval of memorized spatial information.

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.. (1803) ..

**Processing of negative stimuli facilitates event-based prospective memory only under low memory load.** TIZIANA PEDALE<sup>1,2,3</sup>, DEMIS BASSO<sup>4</sup> & VALERIO SANTANGELO<sup>3,5</sup>; <sup>1</sup>National Research University - Higher School of Economics, Russian Federation; <sup>2</sup>Sapienza University of Rome, Italy; <sup>3</sup>Santa Lucia Foundation, Italy; <sup>4</sup>Free University of Bozen, Italy; <sup>5</sup>University of Perugia, Italy

Background: Event-based prospective memory is related to the ability to execute a previously planned action at the appropriate situation. Previous literature showed enhanced performance when negative stimuli are used as prospective memory targets. However, it was entirely unexplored whether this effect is susceptible to prospective memory load, related to the number of target events that are relevant for the pending prospective memory task.

Method: Here we presented participants with angry or neutral faces for an identity judgment (ongoing task). A different number of faces, depending on low vs. high levels of prospective memory load, served as prospective memory targets. Upon the occurrence of certain target faces, with either

neutral or angry facial expression, participants had to refrain from responding to the ongoing task and instead press another response button (prospective memory task).

Results: The results showed better prospective memory performance following negative than neutral targets, but only under low levels of prospective memory load.

Discussion: These findings provide additional support to the notion that negative targets can enhance prospective memory performance, revealing however for the first time that the bottom-up facilitation driven by negative stimuli serving as prospective memory targets dramatically depends on the available attention resources allocated for monitoring the incoming information.

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.. (1804) ..

**Detecting concealed memory of personally familiar faces via eye movements.** ORYAH LANCY, TAL NAHARI, GERSHON BEN-SHAKHAR & YONI PERTZOV; *The Hebrew University of Jerusalem, Israel*

Can gaze tracking be used to reveal whether someone is familiar with another person, even when she tries to conceal this familiarity? During visual processing, gaze allocation is influenced not only by features of the visual input, but also by previous exposure to objects, resulting in idiosyncratic scanning patterns. However, the precise dynamic of gaze allocation towards familiar objects have not been studied in the context of revealing concealed familiarity. Here we show that when subjects try to encode several faces, gaze is inevitably attracted towards a personally familiar face, followed by a strong repulsion, even when participants were explicitly instructed to conceal their familiarity. Despite attracting less encoding time, familiar faces were nevertheless reported more accurately. When exploiting these behavioral patterns, a machine learning classification algorithm could detect the familiar faces at an accuracy rate exceeding 91%. These results shed new light on the temporal aspects of attention preferences and the efficient way in which existing memory representations are encoded into short term memory. It also provides a highly accurate method of detecting concealed information using simple eye tracking technology that does not require a direct contact with the subject. Our research opens the door towards a more comprehensive understanding of the dynamics of attention allocation through time, and towards an application of these theoretical insights for the benefit of our society.

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.. (1805) ..

**The role of Visual Working Memory in Minimally Invasive Surgery: A new perspective.** TINA VAJSBAHER & HOLGER SCHULTHEIS; *University of Bremen, Germany*

Spatial cognition is known to play an important role in minimally invasive surgery (MIS), as it enables faster surgical skill acquisition, reduces surgical time and errors made and significantly improves surgical performance. Nevertheless, no study has yet attempted to summarize the available literature, in aim to provide an overview of which specific spatial abilities are important and how they individually impact surgical performance. We therefore systematically reviewed psychological and medical literature investigating spatial cognition in the context of MIS. A total of 26 studies satisfied this criterion, with most exploring the relationship between spatial cognitive abilities and performance on surgical simulators. The review yielded four main findings: First, spatial cognition was found to have a clear impact on performance. Second, mental rotation ability and mental practice abilities marked significant influence on performance. Third, the technical setup of the MIS equipment has a marked influence. Fourth, both box trainers and virtual reality simulators (VRS) were found to be an effective method for acquiring and mastering surgical skills. In the light of our review findings and their relation to previous hypotheses about spatial cognition in MIS, we propose that Visual working memory may play a more important role in MIS than existing work has considered.

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.. (1806) ..

**Whom to believe? Gender effect in false memories: A meta-analysis.** ELISHEVA BENARTZI<sup>1</sup> & MICHAL RAVEH<sup>2</sup>; <sup>1</sup>*The Center for Academic Studies, Israel*; <sup>2</sup>*Werner Galilee College, Israel*

A meta-analysis examining gender differences in discriminability between true and false memories for various stimuli was carried out on observations from 29 experimental conditions. The primary purpose of the analysis was to examine the mean gender effect on false memories using sensitivity (d-prime) as the main measure. In addition, we examined gender effect on true and false memories separately. The grand effect was not found significant, but the true variance between studies was large and significant. Moderator variables included type of stimulus and participants' age. Meta-regressions and subgroup analyses were used to examine the moderators' effects revealing complex patterns of relationships.

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.. (1807) ..

**Is spelling memory improved by reading aloud ?** MANUEL GIMENES & ERIC LAMBERT; *University of Poitiers, France*

Reading a word aloud allows for better memory performance than simply reading it silently (MacLeod et al., 2010). This production effect is robust but little is known about the kind of representations that undergird it. Does the production effect rely only on phonological representations or also on orthographic representations ? In three experiments, the MacLeod et al. (2010) procedure was used: In a first phase (learning phase), pseudowords were read silently or aloud according to their color. In a second phase (test phase), a recognition task was used with all the pseudowords presented in the learning phase (the « targets » for which French participants had to answer « yes ») and with an equal number of fillers (participants had to answer « no »). In the first experiment, the fillers in the test phase (e.g., ganud) were phonologically and orthographically different from the targets (e.g., pasto). The results showed that recognition accuracy was greater in the reading aloud condition than in the reading silently condition (30% difference). In the second experiment, the phonological information was reduced: the fillers (e.g., pavto) differed by only one phoneme from the targets (e.g., pasto). The results showed a weaker but still significant production effect (13% difference). In the third experiment, phonological information was not available to distinguish fillers from targets, and only orthographic information was helpful. For instance, if the pseudoword « pasto » was presented in the learning phase, the corresponding filler « pasteau » was presented in the test phase (both pseudowords were phonologically identical in French but orthographically different). Although much smaller, the production effect still remained (5% difference). Overall, the results showed that the production effect is mainly based on phonological information but it can be observed even when only orthographic information is available.

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.. (1808) ..

**Studying texts in a second language: the importance of test type.** HELEEN VANDER BEKEN & MARC BRYSAERT; *Ghent University, Belgium*

With academic internationalisation and globalisation at full speed, many people are taking courses in a language different from their native tongue. The question arises whether students remember texts in a second language as well as in a first language.

Bilingualism research generally assumes that meaning is stored language-independently, though this has not been tested at the text level yet. At

the same time, there is accumulating evidence in favour of language-specificity in word list recall, listening comprehension, and autobiographical memory studies, raising the question to what extent text memory may be language-dependent as well.

In this study, we presented participants with a true-false judgement task (recognition) and a free recall task (reproduction) measuring immediate retrieval of short expository texts in L1 and L2 (between-participants). In addition, proficiency, working memory, and reading motivation were tested to match participants ( $N = 195$ ).

Results show worse L2 test scores in recall ( $d = .86$ ), while L2 recognition scores barely differ from those in L1. So, either L2 production is worse, but L2 memory is not, or L2 memory traces are weaker and, as a consequence, available for cued retrieval only. In both cases, these results are practically relevant to examiners in higher education.

To find out whether this recall cost was caused by a lack of L2 production skills or a weaker mental model of the text in English, we decided to test recognition memory on the long term. If the memory traces are weaker indeed, the rate of forgetting ought to be larger in L2 than L1. In this study, we found no significant difference between languages in recognition memory after a day, a week, or a month. This suggests that the recall cost does not originate in the storage or retrieval process, but in the production process.

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.. (1809) ..

**Common and distinct neural correlates involved with active exploration of visual and auditory virtual maps.** AURORA RIZZA<sup>1</sup>, CLARISSA CAVALLINA<sup>2</sup>, MARTA OLIVETTI BELARDINELLI<sup>1,3</sup> & VALERIO SANTANGELO<sup>2,4</sup>; <sup>1</sup>*Department of Psychology, Sapienza University of Rome, Italy*; <sup>2</sup>*Department of Philosophy, Social Sciences & Education, University of Perugia, Italy*; <sup>3</sup>*ECONA, Interuniversity Centre for the Research on Cognitive Processing in Natural and Artificial Systems*; <sup>4</sup>*Neuroimaging Laboratory, Santa Lucia Foundation, Rome, Italy*

Nowadays, people are often engaged with the exploration of visual and/or auditory virtual maps. It is not clear yet how this type of information is encoded and retrieved following “active” exploration. Here we address this issue, additionally asking whether visual and auditory internal representation is sustained by supramodal or modality-specific brain circuits. During fMRI scanning, we asked participants to explore virtual environments represented by grids of three or six cells (low vs. high memory load conditions, L/HML) using four arrow keys. During their active exploration, participants had to encode the position of different

shades of green color (visual grids) or the positions of different pitches (auditory grids). At retrieval, we presented participants with a target shade or pitch on a given cell of the grid. Participants indicated whether that target stimulus was the same or not as in the original grid, and then provided a confidence judgment. The behavioral results showed lower performance for HML vs. LML trials, irrespective of the sensory modality, and greater performance for auditory vs. visual trials, irrespective of load. At the neural level, successful encoding and retrieval of HML vs. LML trials increased activity in the dorsal fronto-parietal cortex, irrespective of trial modality. Together with this supramodal circuit, we found increased activity in the left insula and superior temporal cortex during the encoding of HML auditory trials, which may support the behavioral advantage in the auditory task. Taken together, these findings highlight common and distinct correlates sustaining active exploration of visual and auditory spatial-related information.

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.. (1810) ..

**Interactivity Reduces the Effects of Stereotype threat on Maths performance and Working memory.** ANNA-STIINA WALLINHEIMO, HARRIET TENENBAUM & ADRIAN BANKS; *University of Surrey, United Kingdom*

Background:

The purpose of the current study was to investigate the role of interactivity (allowing the use of external artefacts, e.g. pen and paper) in defusing the impact of stereotype threat on modular arithmetic tasks.

Method:

Sixty-six university undergraduates participated in this study in return for course credits. The participants were pre-tested on basic arithmetic skills, maths self-efficacy and maths anxiety (trait anxiety) one week before the actual experiment. Participants carried out modular arithmetic tasks that acted as novel tasks in a stereotype threat (the participants were told that females perform worse in the tasks) or control condition, crossed with interactivity or no interactivity. The primary dependent variables were the overall performance of the participants in working memory, accuracy (percentage correct), latency to solution, and mathematics anxiety (state anxiety).

Results:

Working memory capacity of the participants with low maths self-efficacy was depleted when stereotype threat was made salient. When in the stereotype threat condition, the highly maths anxious participants' accuracy (percentage correct) was improved when the participants were allowed to externalise the internal cognitive process of com-

pleting the modular arithmetic tasks, by using a pen and paper. Finally, the highly maths anxious individuals felt more maths anxious after being conditioned into the stereotype threat condition. However, these maths anxiety levels were reduced with the help of interactivity: the participants that completed the modular arithmetic tasks in the interactive condition, were less maths anxious after the maths task (carry-on effects).

Discussion:

These findings suggest that interactivity diminished the effects of stereotype threat and maths anxiety on modular arithmetic tasks. These findings underscore the importance of giving the maths-anxious individuals the opportunity to reshape the presentation of the mathematical problems to extend their cognitive systems. By doing this, the working memory capacity can be augmented and as a consequence, the maths performance enhanced.

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.. (1811) ..

**When the source of false memories helps differentiating mild cognitive impairment from Alzheimer's disease.**

GUILLAUME VALLET<sup>1</sup>, NATHALIE BIER<sup>2</sup>, MAXIME LUSSIER<sup>2</sup>, ISABELLE ROULEAU<sup>3</sup> & SVEN JOUBERT<sup>2</sup>; <sup>1</sup>Université Clermont Auvergne, CNRS, LAPSCO (Clermont-Ferrand, France); <sup>2</sup>Université de Montréal, CRIGUM (Montreal, Canada); <sup>3</sup>Université du Québec à Montréal, CHUM (Montreal, Canada)

**Background.** Episodic memory impairment is at the core of amnesic Mild Cognitive Impairment (aMCI) and Alzheimer's Disease (AD). Typically, persons with these conditions make more memory errors than control participants. Nonetheless, these two groups of patients exhibit the same kinds of memory errors in recognition. The present study aims at exploring whether the source of the memory errors may help to distinguish aMCI from AD.

**Method.** Three groups of participants, 25 healthy elderly adults (HE), 20 aMCI patients and 9 AD patients, selectively learned 15 words (underlined) always presented along with a distractor (not underlined). After a brief delay, they completed a yes/no recognition task in which the targets were mixed with the distractors. Half of the distractors were from the learning phase (old condition) and the other half were new words (new condition). Old and new distractors could belong to the same category (close condition: kettle-coffee maker), to a related category (kettle-herbal tea), or to an unrelated category (kettle-spinning top) to the target.

**Results.** As expected, HE showed the best memory performance followed by the aMCI patients and finally the AD patients. The same pat-

tern of results was observed for the memory errors in the new condition. However, aMCI and AD patients exhibited similar performance in the close condition. Reversely, the biggest gap in performance between these groups was found in the old close distractor condition, whereas similar performance was found in the other conditions.

**Discussion.** The results suggest that both quantity and quality of memories should be taken into account in the evaluation of memory performance. AD patients present more qualitatively impaired memory representations than aMCI patients (Vallet, Rouleau et al., 2016). This study highlights the usefulness of a selective learning procedure to distinguish between aMCI and AD as proposed in the binding memory test (Buschke, 2014).

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.. (1812) ..

**A Latent Factor Analysis of Working Memory Measures Using Large-Scale Data.**

OTTO WARIS<sup>1</sup>, ANNA SOVERI<sup>1</sup>, MIKKKA AHTI<sup>2</sup>, RUSSELL COHEN HOFFING<sup>3</sup>, DANIEL VENTUS<sup>1</sup>, SUSANNE M. JÄGGI<sup>4</sup>, AARON R. SEITZ<sup>3</sup> & MATTI LAINE<sup>1,5</sup>; <sup>1</sup>Abo Akademi University, Finland; <sup>2</sup>University of Turku, Finland; <sup>3</sup>University of California, Riverside, USA; <sup>4</sup>University of California, Irvine, USA; <sup>5</sup>Turku Brain and Mind Center, University of Turku, Finland

**Background**

Working memory (WM) is a key cognitive system but its mental structure is not yet clear. A number of structural WM models have been put forth especially by factor analytical studies. In broad terms, these models vary by their emphasis on WM contents (e.g. visuospatial, verbal) vs. WM processes (e.g., maintenance, updating) as critical, dissociable elements.

**Methods**

We conducted confirmatory and exploratory factor analyses on a battery of 10 WM tasks, half of them numerical-verbal and half of them visuospatial, representing four commonly used task paradigms: simple span, complex span, running memory, and n-back. The selection of the tasks allowed the detection of both content- and process-based divisions of WM structure. The data were collected online which allowed the recruitment of a large and demographically diverse sample of adults (n=711).

**Results and Discussion**

Both factor analytical methods pointed to a clear division according to task content (visuospatial, numerical-verbal) for all paradigms except n-back, while there was no indication for a process-based division. Besides the content-based division, confirmatory factor analyses supported a model that also included a general WM factor. The n-back tasks had the highest loadings on the general factor,

suggesting that this factor reflected high-level cognitive resources such as executive functioning and fluid intelligence that are engaged with all WM tasks, and possibly even more so with the n-back. Altogether, our results suggest that process-based divisions of WM presented in the literature are not particularly robust to large samples outside of the laboratory context.

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.. (1813) ..

**An Associative Learning Model of the Spacing Effect in Recognition.** ROBERT COLLINS & BRUCE MILLIKEN; *McMaster University, Canada*

Collins, Rosner, and Milliken (in press; Rosner et al., in press) reported a counter intuitive effect in recognition; memory for words presented twice at study was inferior to words presented only once. During an incidental study phase, participants saw pairs of words displayed in quick succession. Each pair consisted of a green prime word followed by a red target word. Participants in all groups named the target word aloud, while the encoding task for the prime word varied. The study phase was followed by a recognition memory test. When encoding of the prime was poor, memory was worse for repeated words (matching prime/target pairs) than for not-repeated words (unique prime/target pairs). When encoding of the prime was robust, memory for repeated words was improved compared to not-repeated words. These results roughly resemble research on desirable difficulty (Bjork & Bjork, 2011). The present experiment explores whether this effect is constrained by the temporal gap between the prime and target. Using a within-subject design, we contrast the effect of immediate vs. spaced (approximately 10 minutes) repetitions. We replicated the immediate repetition effects from prior work (Collins et al., in press; Rosner et al., in press); more importantly, spacing repetitions always resulted in improved recognition for repeated words over not-repeated words – the spacing effect (Ebbinghaus, 1885). How can repetition both impair and benefit memory depending on temporal gap? We suggest a single process may explain both effects: discrepancy encoding. To-be-learned information is compared against representations in working memory, and only those representations unique to the new experience are encoded in long-term memory. Consequently, low-level processing of primes that matches that for targets may undermine encoding of an episodic trace that supports recognition. We use MINERVA-AL to illustrate how this encoding process efficiently captures all of the observed effects.

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## Poster Session II Ground, Monday, 10:40 – 12:00

.. (2001) ..

**Resolving Interference by Inhibition: An investigation with category-based retrieval after the Think/No-Think procedure.** SATORU NISHIYAMA & SATORU SAITO; *Kyoto University, Japan*

Remembering an item causes forgetting of other items in the same category (retrieval induced forgetting; RIF). This is due to inhibition of the forgotten items that could interfere with the retrieval of target item. This inhibition account of RIF posits that suppressing competitive items in advance makes it easier to retrieve target items that may be subject to interference. Nishiyama and Saito (2017) examined this prediction with the Think/No-Think (TNT) paradigm, which is known to demonstrate item forgetting and thus item suppression, through the repeated attempts to not think about the target item. However, the experiment did not demonstrate the predicted retrieval facilitation. The typical TNT experiments consist of three phases: cue-target learning, TNT task, and recall test. In Nishiyama and Saito (2017)'s experiment, a category-target association phase was added where targets were explicitly associated with certain semantic categories in order to induce interference. This additional procedure led participants to make cue-category-target associations that might have masked the retrieval facilitation. In the present experiment, targets were selected from pre-existing semantic categories to remove the category-target association phase. After the initial learning phase in which targets were encoded with non-categorical cues, pre-existing categories were assigned to three conditions: think, no-think, and baseline. In the TNT task, half of targets in the no-think categories were subjected to no-think trials where participants tried to not think about them when exposed to their learned cues. Finally, in the recall test, participants recalled each target item from a combination of a category and letter cue. We found a tendency for higher recall rate of non-suppressed targets in the no-think categories than that of targets in the baseline categories, but this was not statistically significant. This limited facilitation indicates the presence of possible dynamic processes that emerge during retrieval of items from certain categories.

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.. (2002) ..

**The effect of social presence on working memory: an attentional or phonological cost ?** CLÉMENT BELLETIER & VALÉRIE CAMOS; *Université de Fribourg, Switzerland*

Evidence accumulated for more than a century on audience effects shows that being watched by evaluative others typically impairs performance on difficult tasks. Recent results suggest that this effect may be due to reduced executive control (Belletier et al, 2015). Nonetheless, the exact way by which cognitive control is impacted remains unclear. Two main - non exclusive - hypotheses propose that different cognitive mechanisms may be involved. First, others' presence would trigger task-irrelevant thoughts that consume working memory resources therefore no longer available for task completion (Beilock, Rydell, & McConnell, 2007). Accordingly, only phonological information maintenance and its manipulation in working memory should be deteriorated. Second, the presence of others would automatically capture attention away from the task at hand, which in turn deteriorates performance on difficult or attention-demanding tasks (Baron, 1986; Huguet, Galvaing, Monteil, & Dumas, 1999; Muller & Butera, 2007; Normand, Bouquet, & Croizet, 2014). In other words, executive attention would be less enable under social presence. Interestingly, the Time-Based Resource-Sharing (TBRS) model of working memory offers a similar theoretical dissociation (Barrouillet, Bernardin, & Camos, 2004). Indeed, according to TBRS model, two mechanisms are involved in verbal maintenance: phonological rehearsal and attentional refreshing. Thus, it might be suggested that either one or the other mechanism can be impacted by social presence depending on the considered hypothesis. Using manipulation of cognitive load and articulatory suppression (to impair attentional refreshing and subvocal rehearsal, respectively), we conducted two experiments to disentangle and precise the effects of social presence on cognitive mechanisms in working memory.

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.. (2003) ..

**Nutrition, exercise, and working memory.** ANNA SOVERI<sup>1</sup>, MINNA LEHTONEN<sup>1</sup>, OTTO WARIS<sup>1</sup>, JAN ANTIFOLK<sup>1</sup> & MATTI LAINE<sup>1,2</sup>; <sup>1</sup>*Abo Akademi University, Finland*; <sup>2</sup>*Turku Brain and Mind Center*

**Background:** We explored the relationships between physical exercise and a healthy diet, and working memory (WM) performance in a large and demographically diverse sample of adults.

**Methods:** A large sample (n = 639; age range: 18-71 years) collected online, completed an extensive background survey and 10 WM tasks. Half of these tasks were verbal and half nonverbal. Hier-

archical linear regression analyses were run on verbal and nonverbal WM composites (the composites were based on exploratory factor analysis). At stage one, the predictors age, education, medical diagnoses, and BMI were entered in the model. At stage two, we entered the two predictors of interest, namely exercise and a healthy diet composite comprising the weekly consumption of nine healthy foodstuffs (coffee, tea, berries, nuts, vegetable oil, fish, soy, dark chocolate, and vegetables).

**Results:** For nonverbal but not for verbal WM, adding exercise and healthy diet to the model resulted in a statistically significant increase in R2 and the full model for nonverbal WM explained 6% of the variation. Concerning individual predictors, intake of healthy foodstuffs had a statistically significant but weak positive relationship with nonverbal WM. Also exercise was a statistically significant but weak predictor of nonverbal WM, but so that more frequent vigorous exercise was associated with worse performance.

**Conclusions:** Healthy diet and exercise moderate only the more age-sensitive nonverbal WM. The effects are quite weak but significant, and they go in opposite directions. While a healthy diet predicted better nonverbal WM, exercise and nonverbal WM showed an unexpected negative association. The latter one may reflect a more complex, curvilinear relationship between exercise and nonverbal WM.

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.. (2004) ..

**Influences of cognitive load on learning performance, speech and physiological parameters in a dual-task setting.** MARIA WIRZBERGER<sup>1</sup>, ROBERT HERMS<sup>2</sup>, SHIRIN ESMAELI BIJARSARI<sup>1</sup>, GÜNTER DANIEL REY<sup>1</sup> & MAXIMILIAN EIBL<sup>2</sup>; <sup>1</sup>*TU Chemnitz, E-Learning and New Media, Chemnitz, Germany*; <sup>2</sup>*TU Chemnitz, Media Informatics, Chemnitz, Germany*

The increasing use of digital media in learning scenarios has far-reaching implications for demands on learners' cognitive resources in instructional settings. In this context, the prominent Cognitive Load Theory shapes the construct of cognitive load and postulates distinct facets that contribute to its overall amount. While task complexity relative to learners' previous knowledge constitutes intrinsic cognitive load, extraneous cognitive load arises from inappropriate instructional design. Besides these structural features, the process-related germane cognitive load represents the respective level of schema acquisition and automation. Based on this framework, the study intended to provide insights into the progression and interaction of the outlined facets of cognitive load over the task by applying a multi-method approach of cognitive load assessment. The tested sample of 123 student participants (M = 22.67 years, SD = 3.55,

76.42 % female) completed either an easy or difficult learning task comprising a dual-task approach: a visual-motor primary task required to learn combinations of geometrical symbols while memorizing five-digit number sequences from an auditory-verbal secondary task. Task complexity was manipulated by the number of symbols that formed a combination (three to four) while secondary task demands were regarded as extraneous situational constraints. Participants' learning performance within each trial provided a continuous assessment of schema acquisition. To further address participants' cognitive load, relevant speech (tempo, pauses) and physiological parameters (SCR, HR) were recorded. Results revealed logarithmic progressions of primary and secondary task performance over the trials. Significant logarithmic decreases in speech and physiological parameters indicate a reduction in the overall level of cognitive load with task progression. Taken together, the observed pattern of evidence supports the idea of a logarithmically decreasing progression of cognitive load with increasing schema acquisition. Since extraneous and intrinsic cognitive load were induced at a constant level, an underlying reduction in germane cognitive load can be assumed.

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.. (2005) ..

**Spatial representations for familiar and newly-encoded environments.** MARIANNA PAGKRATIDOU, ADAMANTINI HATZIPANAYIOTI & MARIOS AVRAAMIDES; *Unuversity of Cyprus, Cyprus*

Findings in spatial cognition document that people store spatial information about unfamiliar environments from a preferred orientation, relying on factors such as the symmetry of the layout, the environmental structure, one's learning viewpoint, the experimental instructions, etc. However, what is not yet known is whether memories about familiar environments are also orientation-dependent. The study we conducted investigated spatial reasoning about familiar and unfamiliar environments. Specifically, we asked a group of participants to make perspective-taking judgments for objects located in their own rooms at a university dormitory and we compared their performance with that of controls participants who studied the same rooms in the lab through immersive Virtual Reality. Findings revealed that reasoning about both familiar and unfamiliar environments relies on orientation-dependent representations that can be influenced by situation cues at the time of retrieval. The implications of these results for theories of spatial memory are discussed.

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.. (2006) ..

**Conscious access to position-element frequency knowledge.** MASATAKA NAKAYAMA<sup>1</sup> & SATORU SAITO<sup>2</sup>; <sup>1</sup>*Carnegie Mellon University, United States of America*; <sup>2</sup>*Kyoto University, Japan*

Position-element association is a widely implemented mechanism for short-term serial order memory. A recent study showed long-term position-element associations can be formed via repetitive experience. For example, in a series of immediate serial recall (ISR) tasks, if item A is frequently presented in the first position across different lists, the recall accuracy for A in the first position increases as a function of repetition, beyond a general practice effect. The current study asked whether such position-element frequency knowledge is consciously accessible and how such knowledge is organized. Participants conducted 192 trials of an ISR task in which position-element frequency distribution was manipulated. After the ISR task, they were asked to report the position at which each item tended to be presented. The results showed (a) participants could identify correctly, above chance, the frequently presented position for each item, (b) the position-judgment accuracy was better in the last two positions than in the other positions, (c) the erroneously specified positions tended to be nearby positions (i.e., there was a transposition gradient), (d) participants' confidence in their own position-judgment predicted the actual judgment accuracy, and (e) the position-judgment accuracy predicted the position-item frequency effect in the ISR task only in the first and last positions. In sum, a form of position-element frequency knowledge can be accessed explicitly. The error patterns in the position-judgment were similar to that of short-term serial order memory (i.e., the serial position curve and transposition gradient), suggesting similar organizing principles of short-term and long-term position representation. Further investigation is needed to examine whether the two forms of long-term representation (i.e., that contributes to ISR and that contributes to position-judgment) are identical.

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.. (2007) ..

**How goal cues impact verbal working memory in preschoolers?** CHRISTOPHE FITAMEN<sup>1,2</sup>, VALÉRIE CAMOS<sup>1</sup> & AGNÈS BLAYE<sup>2</sup>; <sup>1</sup>*Université de Fribourg, Switzerland*; <sup>2</sup>*Université d'Aix-Marseille, France*

Goal neglect has been shown to contribute to preschoolers' poor executive control (Chevalier & Blaye, 2009; Blaye & Chevalier, 2011). Yet, it is possible to improve their inhibition and flexibility performance using goal cues during the task (i.e. a colour palette to activate a colour categorisation goal). The current study aimed at extending these find-

ings by examining the extent to which poor working memory performance in preschoolers could be accounted for by a tendency to neglect the goal of having to recall the memoranda at the end of the retention interval. This question was addressed by testing the effect of two forms of goal cueing: visual (Exp. 1 and 2) and auditory (Exp. 3) presented during the retention interval of a Brown-Peterson task. We tested one hundred and fifty-six 5- to 9-year-old children who had to maintain verbal information during either an unfilled interval (Exp. 1) or while performing a naming colour task (Exp. 2 & 3). Compared to a no-cue condition, no impact of a visual cue on memory performance has been found whereas there is a detrimental effect of the auditory cue in all age groups. This pattern of findings clearly contrasts with findings on executive control. Results will be discussed in terms of differences of goal setting costs in flexibility, inhibition and working memory tasks. Further, we will discuss the extent to which the differential effect of visual and auditory cues could suggest that some verbal rehearsal strategies may be already at play as soon as 5 years of age.

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.. (2008) ..

**Selective Updating of Sentences: introducing a new measure of verbal working memory.** DANIEL FELLMAN<sup>1</sup>, ANNA SOVERT<sup>1</sup>, CHARLOTTE VIKTORSSON<sup>1</sup>, SARAH HAGA<sup>1</sup>, JOHANNES NYLUND<sup>1</sup>, SANNA JOHANSSON<sup>1</sup>, JAKOB EDMAN<sup>1</sup>, FELIX VON RENTELN<sup>1</sup> & MATTI LAINE<sup>1,2</sup>; <sup>1</sup>*Abo Akademi University, Finland*; <sup>2</sup>*Turku Brain and Mind Center, Finland*

**Introduction:** Working memory (WM) is highly relevant to human performance, including language processing. The most common sentence-level WM task is the Reading span, but comparable updating tasks are missing. We developed a WM updating task, coined as the Selective Updating of Sentences (SUS) task. In this task, the participant is at first shown a semantically feasible sentence on the screen. At each of the following updating stages, two randomly chosen content words are changed (the rest of the sentence is not shown). At the end of the trial, the participant is to recall the final form of the whole sentence. WM load is manipulated with the number of updating stages and sentence length.

**Objectives:** In two experiments with Finnish-speaking young adults, we examined the internal consistency, concurrent validity, and test-retest reliability of the SUS task. As the SUS task aimed to represent a somewhat more “naturalistic” sentence-level WM measure, we also examined how it was related to verbal episodic memory performances with sentences and paragraphs.

**Methods:** The tasks were performed online in home-based settings in Experiment 1 (N = 169), and in computer classes in Experiment 2 (N = 80). In both experiments, the data was collected with our in-house programmable Internet-based test platform.

**Results:** The results from Experiment 1 indicated that the SUS task exhibited adequate internal consistency and correlated positively with well-established WM measures. The results of Experiment 2 confirmed those findings and further showed that the SUS task demonstrated an adequate level of test-retest reliability, and correlated positively with sentence- and paragraph-level verbal episodic memory.

**Conclusions:** The present results suggest that the SUS task is a reliable and valid sentence-level WM updating task. It should thus be a useful addition to the psycholinguistic toolbox of measures that tap into short-term memory processes during language processing.

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.. (2009) ..

**Expectation in Newly Instructed Tasks.** MAAYAN PEREG<sup>1</sup>, TODD S. BRAVER<sup>2</sup> & NACHSHON MEIRAN<sup>1</sup>; <sup>1</sup>*Ben-Gurion University of the Negev, Israel*; <sup>2</sup>*Washington University in St. Louis, United States*

**Rapid-Instructed Task Learning (RITL)** is the ability to execute novel rules upon instructions; **Intention-Based Reflexivity (IBR)** is the related unintended reflexive activation of these novel rules, when execution is pending. Importantly, assessing IBR requires using a “diagnostic task” that takes place after RITL-instructions and before RITL execution. Moreover, most studies on RITL focused on brain recordings and did not include such a diagnostic task, while it is possible that RITL will express differently if pending execution is introduced in its measurement. In order to address this issue, we manipulated the probability of including a diagnostic task. Our NEXT paradigm involved miniblocks, each comprising (a) RITL instructions involving a novel Stimulus-Response rule; (b) a diagnostic (NEXT) task in which participants advanced the screen with a fixed response that could be in/compatible with the newly instructed rule to assess IBR; and (c) RITL execution. It was found that when the diagnostic task was relatively unlikely, the IBR-related effect increased and RITL performance was enhanced. These results suggest that the potential for IBR is increased in paradigms not involving a diagnostic task.

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.. (2010) ..

**Individual Differences in False Memories: The Role of Need for Cognition.** EDA BAĞCI, PINAR BÜRHAN & HASAN GÜRKAN TEKMAN; *Uludağ University, Turkey*

Background:

Individual differences in need for cognition (NFC) was found to affect false recognition responses elicited in the Deese-Roediger-McDermott (DRM) paradigm. High NFC was observed to lead to an increase in the rate of false recognition. Considering more elaborate processing has led to more "remember" type of recognition judgments in previous research it was expected that greater NFC could affect false memories in a similar way. Hence, the first purpose of this study was to examine the effect of NFC on remember/know judgments at the DRM task. Furthermore, it was expected that participants who are higher in NFC could benefit more from a warning about the possibility of false memory errors compared to participants who are lower in NFC. Thus, the second purpose of this study was to examine the effect of NFC and warning interaction on false recognition.

Method:

One hundred and twenty undergraduate students at Uludağ University are being tested in the DRM paradigm to elicit false recognition. The Turkish version of the NFC Scale (Gülgöz & Sadowski, 1995) is used for measuring NFC levels. Before the DRM task half of the participants are given a warning about the nature of the task.

Results:

Data collection is in progress.

Discussion:

If interactions of NFC with the phenomenology of recognition responses and the warning about errors are observed, this would indicate that persons with higher NFC are more motivated to process the material to be remembered more elaborately and take better advantage of memory warnings.

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.. (2011) ..

**The role of Depression and Rumination in Working Memory: A study with the Internal Shift Task.** DIANA MARINA COSTA & NUNO SOARES GASPAR; *University of Porto, Portugal*

Introduction: Depression and rumination have been associated with memory and attention emotional state congruent biases as well as impairments in executive control function. The ability to control and manipulate information held in working memory (WM) appears to be compromised by the depression symptoms and the rumination. The aim of this study is to evaluate the shifting capacity between internal emotional and non-emotional information present in WM by conducting an oper-

ational replication of Koster, De Lissnyder, Derakshan, and De Raedt's (2011) study.

Method: For this purpose the Internal Shift Task (IST), using faces taken from Karolinska Directed Emotional Faces (Lundqvist, Flykt, & Ohman, 1998), was administered to 63 undergraduates, categorized as dysphoric (n = 26) and non-dysphoric (n = 37) according to the Clinical Assessment Inventory of Depression (Vaz Serra, 1994). For the rumination dimension, the participants were divided into high ruminators (n = 32) and low ruminators (n = 31), according to the median value of The Ruminative Responses Scale (Treynor, Gonzalez, & Nolen-Hoeksema, 2003).

Results: The results show that there are no significant differences in the IST performance based on the dysphoric and non-dysphoric categorization. The switch costs show that the dysphoric individuals have higher reaction times in switching trials, regardless of the condition being emotional or non-emotional. The same pattern of results was obtained for rumination. The analysis of emotion-specific within the emotional condition reveals that in no-switching trials, high ruminators are faster in reacting to emotional stimuli (angry faces).

Discussion: These results fail to support the conclusions regarding the relation between depression symptoms and rumination and switching impairments in response to emotional material drawn by De Lissnyder, Koster, and De Raedt (2011).

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.. (2012) ..

**Are there multiple ways to direct attention in visual working memory?** AMY ATKINSON<sup>1</sup>, ED BERRY<sup>1</sup>, AMANDA WATERMAN<sup>1</sup>, ALAN BADDELEY<sup>2</sup>, GRAHAM HITCH<sup>2</sup>, TAIJI UENO<sup>3</sup> & RICHARD ALLEN<sup>1</sup>; <sup>1</sup>University of Leeds, United Kingdom; <sup>2</sup>University of York, United Kingdom; <sup>3</sup>Takachiho University, Japan

In visual working memory tasks, memory for an item is enhanced if participants are told that particular representation is more valuable (e.g. Hu et al., 2014) or more likely to be tested at retrieval (e.g. Shimi et al., 2014). However, to date, research has not explored whether these effects reflect similar or distinct underlying mechanisms. A series of experiments was conducted to explore this, in which participants were presented with four coloured shapes and then asked to recall the colour of one item following a brief delay. Experiment 1 orthogonally manipulated prioritisation (i.e. whether one item was more valuable than the rest) and probe frequency (i.e. whether one item was more likely to be assessed). Participants were either told to prioritise the first item (prioritisation) or try equally hard to remember all the items (control). In addition, the first item was either assessed as frequently

(low probe frequency) or more frequently than the other items (high probe frequency). Performance at the first item was enhanced by prioritisation and increased probe validity. These effects were additive, suggesting they may reflect different mechanisms. Two follow-up experiments were conducted, which revealed that the probe frequency effect is not reliant on executive resources and is not reduced by visual interference presented in the maintenance period. This directly contrasts with previous findings on the prioritisation effect, which appears to be reliant on executive resources (Hu et al., 2014) and reduced by visual interference (Hu et al., 2016). Taken together, this suggests there are multiple ways attention can be directed in visual working memory, and that these processes are likely to reflect distinct underlying mechanisms.

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.. (2013) ..

**Meta-memory in prospective memory.** GEOFFREY BLONDELLE, MATHIEU HAINSELIN, YANNICK GOUNDEN, LÉA BARDET, GAËLLE AUBERT & VÉRONIQUE QUAGLINO; *Centre de Recherche en Psychologie : Cognition, Psychisme, Organisations, EA 7273, Université de Picardie Jules Verne, Amiens, France*

Background: Prospective memory (PM) is influenced by various cognitive and environmental factors. However, research has focused on the role of meta-memory in PM (Rummel & Meiser, 2013). This present study addressed this issue in sample of healthy individual population. We predicted a positive correlation between PM performance and meta-memory.

Methodology: Thirty-eight young adults (18-25) were included. PM was assessed using the French version of the Virtual Week (Rendell & Craik, 2000). The Questionnaire Amiénois de Mémoire Prospective (QAMP), our new tool that compiles items from existing PM questionnaires, was also proposed to assess meta-memory in PM. The QAMP provides various information such as: a measure of Feeling of Knowing (FOK) index before (prediction) and after (postdiction) the Virtual Week, a total score of omissions for 33 daily life situations, strategies used to avoid omissions and the effectiveness of these strategies for each participant. Results were analyzed by computing Spearman Rank correlations.

Results: Correlation between the number of MP items correctly recalled at the Virtual Week (total score), the FOK (before or after), the number of omissions in daily life, and the effectiveness of the strategies were not significant. However, there was a negative correlation between total score at the Virtual Week and the number of strategies used in daily life ( $r = -.44$ ).

Discussion: Contrary to our prediction, we did

not find a positive correlation between the PM scores and meta-memory. The negative correlation found seems to indicate that the higher the PM performance, the fewer participants declare using strategies to fulfill their future intentions in everyday life. The QAMP, like other PM questionnaires, seems to provide more a PM complaint indicator rather than information on meta-memory.

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.. (2014) ..

**Investigating semantic recall within autobiographical memory narratives.** ALI MAIR<sup>1</sup>, MARIE POIRIER<sup>2</sup> & MARTIN A. CONWAY<sup>2</sup>; <sup>1</sup>*University of Hertfordshire, United Kingdom*; <sup>2</sup>*City, University of London*

In the autobiographical memory (AM) literature, younger adults usually recall more episodic event details while older adults tend to recall more semantic details. Despite several replications of increased semantic recall among older adults, there has been little investigation of what purpose these details serve within AM narratives. One suggestion is that age-related increases in semantic recall reflect a shift in communicative goals and an increase in searching for meaning in older age. Here we report findings from an online study, in which memories recalled by one sample of older and younger participants were rated by a separate sample of older and younger participants on a number of dimensions of story quality. The results showed that older adults' memories were rated more favourably than younger adults' memories, but this was independent of the proportion of semantic details recalled. Instead, memories that were lower in semantic details were rated more positively overall. We also found some preliminary evidence that memories were perceived differently by older and younger adults, possibly suggesting that older adults consider semantic recall to be more story-relevant than do younger adults.

In addition, we report findings from two reanalyses of data collected in earlier studies. In the first, we investigated the relationship between older and younger adults' episodic and semantic recall across different measures of AM, and found systematic variation according to the AM task. Next, we re-coded semantic details recalled by older and younger participants in two previous tasks, to better represent the different subtypes of semantic AM. The results showed significant age-related increases in temporally abstracted event details across both tasks, and age by task interactions for other semantic subtypes. These findings are discussed in relation to the episodic/semantic distinction in AM.

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.. (2015) ..

**What Processes Underlie the Performance of Expert in Chess? Study of Inhibition and Decision-making Processes.** VIRGINIE POSTAL & ROMAIN TRINCHERINI; *University of Bordeaux, France*

The field of expertise arouses since very many years, theories in cognitive psychology to explain what makes the experts' performance exceptional. We present two researches to specify the cognitive processes involved in the expertise. The first (Experience 1) was intended to check the capacity of inhibition of experts comparing three groups of experts to chess in a task of detection of failure to the King and in a task of recall of pieces on the Board with a priming paradigm. The results showed that unlike our assumptions, experts have no inhibition superior to non-experts. More exactly, they don't seem to need to inhibit irrelevant information because they put in place a parallel treatment of the pieces on the Board (Postal, 2012). The second study (Experience 2) was designed to study the capabilities of decision making in expert chess with an adaptation of Iowa Gambling Task (Bechara et al., 1994). Three groups of players in chess were solicited. A computerized version of the IGT has been administered. By studying the evolution of the performance in the task of decision making (300 trials), the results showed the existence of an inflexion point earlier for experts than for non experts. Also novices use in the majority (50%) an inadequate strategy which is to select disadvantageous decks in the long term then that experts use appropriate strategies (86%) including a strategy that is unique. This study shows by empirical scientific experiment that the expertise in chess is related to more efficient decision-making processes.

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.. (2016) ..

**What pupillometry can add to the discussion of cognitive and metacognitive processes during intentional forgetting and remembering.** SEBASTIAN SCHOLZ & STEPHAN DUTKE; *Westfälische-Wilhelms Universität Münster, Germany*

Two experiments are discussed that investigated human ability to intentionally forget presented information. This ability is mainly explained by two theoretical accounts: Selective rehearsal and inhibitory control. Inhibitory control accounts state that forgetting is an active process requiring presented information to be inhibited. In contrast, selective rehearsal accounts emphasize working memory processes that act on the to-be remembered items supporting later retrieval. To-be-forgotten items are simply dropped from working memory and are no longer processed. Thus, inhibitory control accounts postulate higher cognitive load than selective rehearsal accounts. Since pupil size is a reliable

measure of cognitive load the first study investigated whether pupil size can be used to differentiate intentional encoding and forgetting. Participants performed an item-method directed forgetting task and the classical directed forgetting effect was replicated: Participants were able to intentionally forget some information and remember other. Pupils were most dilated following the instruction to encode a previously seen stimulus, intermediately following a neutral instruction, and pupils were least dilated following the instruction to forget a stimulus. This result is best explained by selective rehearsal accounts as the amount of cognitive resources allocated to encoding was higher than the amount of resources associated to forgetting. In the second experiment, the motivation to forget was manipulated by including negative consequences when stimuli are remembered that should be forgotten. This experiment is still running and results from the analyses of memory performance, metacognitive judgments and pupil size will be presented. Results of both experiments will be discussed in the broader context of awareness and intention during forgetting. Particularly we will discuss to what extent intentional and unintentional remembering and forgetting differ in qualitative aspects and which processes enable us to use our memory system efficiently.

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.. (2017) ..

**What is with a water bottle and a gun in hand baggages?** ANNA CONCI<sup>1</sup> & MERIM BILALIĆ<sup>1,2</sup>; <sup>1</sup>*University of Klagenfurt, Austria*; <sup>2</sup>*University of Northumbria, Newcastle*

Visual search involves identifying specific objects, called targets, among numerous other objects, called distractors. People are very good at visual search in everyday life (e.g. recognizing a friend among strangers in a bar). Visual search is of great importance in some jobs, such as luggage screening at airports. The question of expertise in the airport security may be a question of life and death. In order to guarantee a safe flight, the screening operator needs to notice dangerous objects in luggage. Previous studies have found that one of the biggest problems in visual search is the phenomenon subsequent search misses (SSM). These effects suggest that people often cannot find a second target when they have already found one. If the missed target was presented alone people have no problem finding it. One reason why people miss the second object may be that the position and shape of the first found target exhaust the resources of working memory. The SSM effect occurs frequently in the standard laboratory visual search with multiple targets. We assume that this effect is also going to be replicated in the more natural setting - using x-

ray images of hand packages. In the experiment, we simulate the first found object by presenting the participants with an object which they need to keep in memory. The subjects will first see individual objects, which they need to keep in mind while they are executing search. In the control condition, this step is not going to be presented. Then, both groups need to perform visual search, while in the final step, only the first group need to recall the memorized object. The results show a significant difference in the reaction time and the eye movements. Therefore, we can assume that the WM has an influence on the visual search performance.  
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## Poster Session II

### S13, Monday, 10:40 – 12:00

.. (2301) ..

**Retaking Perspective: Perspective Taking Test – Revised.** DANIT GEVA & AVISHAI HENIK; *Ben Gurion University of the Negev, Israel*

Perspective taking tasks are supposed to measure the ability of a person to process and anticipate the appearance of a fixed object (or an array of fixed objects) after a change in his/her perspective (Kozhenikov & Hegarty, 2001).

The Guilford-Zimmerman Spatial Orientation Test (Guilford & Zimmerman, 1948) was the most common test in use for measuring this ability, in spite of its low validity. The Object Perspective Test was developed (Kozhenikov & Hegarty, 2001) and revised (Waller & Kozhenikov, 2004) in order to improve validity. In this test, participants are asked to imagine themselves standing in the place of an object, taking a perspective by 'looking' at a second object and then imagine pointing at a third object. The participants' task is to indicate the angle that was created between their imagined point of view and the third object.

The Object Perspective Test has several limitations, some of which are common to paper and pencil tests. We developed an experimental task that enables a comparison between different perspectives. Specifically, we were interested in the difference between one's own perspective and taking the opposite perspective. Results show that taking one's own perspective produces more accurate evaluations of angles than taking the opposite perspective. Moreover, the type of angle between dots (obtuse vs. sharp) modulates the perspective taking effect. We are currently continuing this line of work to examine effects of manipulating different perspectives.

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.. (2302) ..

**Referential Gaze and its Influence on Situated Language Comprehension: Virtual Agent vs. Human Gaze.** EVA MARIA NUNNEMANN<sup>1</sup>, KIRSTEN BERGMANN<sup>1</sup> & PIA KNOEFERLE<sup>2</sup>; <sup>1</sup>*Bielefeld University, CITEC, Germany*; <sup>2</sup>*Humboldt University of Berlin, Germany*

In face-to-face interactions, referential gaze plays a crucial role for spoken language comprehension. It is exploited in joint-search tasks or for object identification and people are not only able to benefit from human gaze but also from virtual agent gaze. Whereas previous studies exclusively looked at one kind of gaze, our study directly contrasted human speaker and agent listener gaze in a triadic communication situation and their respective effects upon reaction times, accuracy and eye movements.

Participants saw videos depicting a static scene with three characters on a screen. To the sides of this screen a human speaker and a virtual agent listener were visible. Participants' eye movements were recorded while they listened to the speaker's German SVO sentences describing an interaction between two of the three characters on the screen, e.g. The waiter congratulates the millionaire (materials from: Kreysa & Knoeferle, 2011). While the human interlocutor displays speaker gaze behaviour, the virtual agent listener follows her gaze. After each trial a template schematically depicting the characters and their interaction appeared on the screen and participants had to verify whether sentence and template matched. We manipulated: (1) whether the human speaker was visible, (2) whether the agent listener was visible, and (3) whether template and sentence matched.

Across all conditions participants solved the verification task very well. Their responses were faster for matches than mismatches and slower for agent-present trials. Eye tracking results further suggest that participants looked more at the NP2 referent (e.g. the millionaire) in those conditions where the human speaker was visible.

To conclude, when both gaze cues were available, only human speaker but not agent listener gaze guided attention during spoken language comprehension. Although the virtual agent's gaze did not affect incremental language comprehension, his mere presence did impact verification task performance.

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.. (2303) ..

**The Effect of Stimulus Complexity on Strategy Selection in Mental Rotation Task.** BINGLEI ZHAO, ELENA GHERRI & SERGIO DELLA SALA; *Human Cognitive Neuroscience, Psychology, University of Edinburgh, UK*

The complexity effect on mental rotation (MR) has been considered a good indicator to distinguish

between two views of visual imagery (Cooper & Podgorny, 1976): one positing that mental experience plays a functional role in cognition (e.g., Kosslyn), the other postulating that propositional knowledge is sufficient for supporting imagery (e.g., Pylyshyn). To reconcile these two views, it has been suggested that different strategies (i.e., holistic, piecemeal transformation) could be involved in performing MR (Logie et al., 2011; Zeman et al., 2010).

It has been suggested that the strategy adopted to perform a MR task is to examine whether the reaction times (RTs) are independent of the stimulus complexity. Such independence would suggest that a holistic strategy is at play; otherwise, piecemeal transformation is adopted. However, stimulus complexity can vary according to its outline pattern or to the number of segments involved. It is unknown which strategy would be utilized when complying with different types of stimulus complexity. To explore this question, twenty-four young adults were assessed with MR tasks with different stimulus complexity. The stimulus complexity was manipulated by two factors: the number of segments and of vertices. There was no effect of number of vertices, indicating the use of a holistic strategy in integrated and two-segment objects. On the contrary, a main effect of segments number was found suggesting that piecemeal transformation was at play in multi-part stimuli which contains more than two segments. These results refine Cooper and Podgorny's (1976) complexity effect and characterize the strategies adopted to process stimuli of different type of complexity in MR.  
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.. (2304) ..

**Cognitive development attenuates audiovisual distraction and promotes the integration of low-level perceptual saliency during visual search on complex scenes.** CLARISSA CAVALLINA<sup>1</sup>, GIOVANNA PUCCIO<sup>1</sup>, MICHELE CAPURSO<sup>1</sup>, ANDY BREMNER<sup>2</sup> & VALERIO SANTANGELO<sup>1,3</sup>; <sup>1</sup>*Department of Philosophy, Social Sciences & Education, University of Perugia, Italy;* <sup>2</sup>*Department of Psychology, Goldsmiths University of London, UK;* <sup>3</sup>*Neuroimaging Laboratory, Santa Lucia Foundation, Rome, Italy*

Searching for a target while avoiding distraction is a core function involving both voluntary and reflexive mechanisms of selective attention. Here we investigated for the first time what is the impact of attention control – indexed by different levels of cognitive development – on the interplay between voluntary and reflexive mechanisms of selective attention during a visual search task. We asked 6-year-olds, 10-year-olds and 20-year-olds participants to search for a target in a complex scene, preceded by auditory pre-cues that were

either spatially-congruent, spatially-incongruent, or spatially-uninformative with respect to the hemifield in which the target was presented (i.e., valid, invalid or neutral trials). For each scene we also computed the target saliency (TgS) and the number of salient locations in the scene (NSL). We found comparable orienting effects (valid minus neutral trials) in the three age groups, indicating inefficiency in resisting from auditory distraction irrespective of cognitive development. However, only in adults we found a suppression of the re-orienting effect (invalid minus neutral trials), evidencing a faster re-allocation of selective attention toward the target. Searching performance for 6- and 10-year-olds children was predicted by the NSL, indicating a dispersion of processing resources on salient but task-irrelevant locations; conversely, only adults made use of task-related saliency, with greater performance following increased TgS in valid trials. These findings highlight qualitatively different mechanisms of selective attention operating at different ages, demonstrating the key role played by cognitive development in the interplay between voluntary and reflexive mechanisms of selective attention during visual search on complex scenes.

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.. (2305) ..

**The inefficiency of efficiency measures: The case of speed as an exemplar.** EYAL GAMLIEL<sup>1</sup> & EYAL PEER<sup>2</sup>; <sup>1</sup>*Ruppin Academic Center, Israel;* <sup>2</sup>*Bar Ilan University, Israel*

#### Background

This paper construes two cognitive biases, namely time saving bias and average speed fallacy, as specific cases of the inefficiency of efficiency measures. Defining speed as a time-efficiency measure, we show that the two cognitive biases are analogous to the respective fuel-efficiency illusion ("the MPG illusion"), and the average fuel-efficiency fallacy. Because the relation between efficiency measures and consumption measures is curvilinear, summations and subtractions, that are legitimate when applied on consumption measures, cannot be applied on efficiency measures. We hypothesized that as people are unaware of that, facing time-efficiency (i.e., speed) measures they would calculate differences and compute arithmetic averages, that would result in biased judgments and sub-optimal decisions. We further hypothesized that these biases would not correlate with low numerical skills.

#### Method

71 undergraduates were asked to rank five options of time savings and five options of average speeds. The five options were constructed such that the correct order was the exact opposite of the order obtained by calculating differences or arith-



metic averages of the speed values. Participants also completed a numeracy scale.

#### Results

79% of the participants ordered the options in perfect match to the difference between the speed values. In addition, 63% ordered the speed values in perfect match to the arithmetic speed average. Small and insignificant correlations were found between the above ranking patterns and numeracy.

#### Discussion

Participants typically apply summations and subtractions to time-efficiency (i.e., speed) values, leading to biased judgments and sub-optimal decisions. These biases are analogous to fuel-efficiency biases ("the MPG illusion"). All these biases result from calculating differences and summations on efficiency measures, although these can only be calculated on consumption measures because of the non-linear relation between efficiency and consumption measures. We discuss possible remedies for these biases, concluding that using efficiency measures could be inefficient.

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.. (2306) ..

**Implicit sequence learning despite multitasking – the role of across-task predictability.** EVA RÖTTGER<sup>1</sup>, HILDE HAIDER<sup>1</sup>, FANG ZHAO<sup>2</sup> & ROBERT GASCHLER<sup>2</sup>; <sup>1</sup>University of Cologne, Germany; <sup>2</sup>FernUniversität in Hagen, Germany

One frequently replicated finding is that implicit sequence learning is reduced in dual-task situations. Schumacher and Schwarb (2009) found no manifestation of it when a serial reaction time task (SRTT; Nissen & Bullemer, 1987) had to be performed simultaneously with a (random) two-choice tone-identification task. The authors concluded that parallel response selection / central capacity sharing (e.g., Tombu & Jolicoeur, 2003, 2005) disturbs sequence learning.

On the other hand, Schmidtke and Heuer (1997) found that impaired dual-task sequence learning resulted from task integration whenever the secondary task events were random. With perfectly correlated sequences in both tasks, however, sequence learning occurred.

Another way to interpret both findings is that the random elements of one task, occurring in close temporal contiguity to the regular elements of the other task, introduced co-occurrences of events that had no predictive value. Thus, they prevented the minimization of the prediction error - that is, they prevented associative learning (e.g., Rah, Reber & Hsiao, 2000).

We conducted several experiments using the design of Schumacher and Schwarb (2009). Crucially, we manipulated the tone-identification task

in different ways. For example, we paired 50% of the SRTT sequence consistently- but the other 50% randomly with the tones. Our single-task test phase revealed substantial learning of exclusively the (formerly) consistently paired sequence positions – while the learning effect for the (formerly) randomly paired positions was even reversed. In case of this latter finding, we suggest that response conflicts due to wrong across-task predictions prevented the strengthening of associations between successive SRTT-elements. Additionally, the results suggest that the participants had learned the ordinal sequence positions (see, e.g., Schuck, Gaschler, & Frensch, 2012) of predictable vs. unpredictable co-occurrences.

Overall, our results support the assumption that increasing the across-task predictability preserves implicit sequence learning in dual-task situations.

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.. (2307) ..

**The role of emotions in the intentionality attribution.** MICAELA MARIA ZUCHELLI, RAFFAELLA NORI, ELISA GAMBETTI, FABIO MARINELLO & FIORELLA GIUSBERTI; *University of Bologna, Italy*

According to the "Knobe Effect" (KE) people tend to judge a negative side effect (SE) as intentional while a positive one as unintentional (Knobe, 2003). The emotional hypothesis (e.g. Nadelhoffer, 2004) suggested that negative emotions elicited by the negative SE are responsible of the intentionality attribution increase but no differences were found in patients who exhibit emotional deficits due to ventromedial damage (Young et al., 2006). Recently amygdala has been proposed as emotional area involved (Ngo et al., 2015). To elucidate the influence of negative emotions on intentionality judgments, we differentiated the emotional salience of SEs (standard, like Knobe scenario, and more intense) and administered them to a group of alexithymic participants, who exhibit emotional deficits connected to lower activation of amygdala (vanderVelde et al., 2013).

Twenty high (HA) and twenty low (LA) alexithymic provided intentionality judgments to Knobe scenarios, half with standard salience SEs (e.g. environment damage/benefit) and half with higher salience SEs (e.g. children death/safety). Subjective activation reports (SAR) and skin conductance levels (SCL) were collected.

Both groups increase their intentionality judgments, SAR and SCL in the high salience condition ( $F_{1,38}=115.62, F_{1,38}=130.74, F_{1,29}=420.85; ps<.001$ ). In the standard salience condition, HA showed lower intentionality judgments and SAR for the negative SE ( $F_{1,38}=11.92, p<.001; F_{1,38}=4.48, p<.05$ ) compared to LA, while in the high saliency condition there were no differences between groups.

HA's SCL was lower, compared to LA, in both conditions ( $F(1,29)=8.08, p<.05$ ).

The influence of emotions on the KE was confirmed by increase of intentionality judgments, SAR and SCL in the higher salience condition. Amygdala could represent the neural substrate involved since HA, who exhibit emotional deficits connected to this area, exhibited significantly lower intentionality judgments and activation levels for negative SEs in the standard saliency condition, compared to LA. Instead, when faced with high salient SEs, these differences disappeared supporting that alexithymic individuals modulate their emotional response with more salient stimuli.

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.. (2308) ..

**Ew! Disgust perception in native and foreign languages.** CANDICE FRANCES & JON ANDONI DUNABEITIA; *Basque Center on Cognition, Brain and Language (BCBL), Donostia, Spain*

The current study focuses on the effects of foreign language on one specific emotion: core disgust, which is particularly dissociated from other emotions and culturally universal. We asked 340 native Spanish speakers to report the level of disgust that pictures of insects and mammals evoked, on a scale from 1 (not at all disgusting) to 5 (extremely disgusting) as well as how much they wanted to kill each of the insects. Half of the participants completed the study in their native language (Spanish) and half in their foreign language (English). Participants were more willing to report a socially undesirable emotion (higher disgust scores) and urges (higher desire to kill scores) in a foreign language. This leads to the conclusion that reduced emotionality alone does not explain the foreign language effect; but rather, this is a more complex phenomenon that affects several aspects of how we perceive and communicate emotions. Although further research is needed on the topic, it could be argued that surveys in a foreign language carry more honest answers and decrease inhibition. Email: c.frances@bcbl.eu

.. (2309) ..

**The influence of perspective taking on control processes.** ALICJA GNIEWEK; *University of Warsaw, Faculty of Psychology, Poland*

The aim of the research is the exploration of the relationship between selected aspects of inhibitory control and perspective taking. Perspective taking (construed as situational strategy or individual disposition) is a conscious, intentional, and energy-consuming process (Gehlbach, Brinkworth, Te Wang, 2012, Kahneman, 2013). It involves the observer recording thoughts and emo-

tions of other people, while recognizing their distinct points of view (Gehlbach, 2004). Little is known about the cognitive determinants of perspective taking. Increasing reports suggest that it is associated with cognitive control (Mischel, 2015) and activates the regions of prefrontal cortex (Posner, Rothbart, 2006) responsible for executive functions (Alvarez, Emory, 2006, Diamond, 2013). Research imply also that there is a relationship between reflexive processing and control over eye movements as symptoms of attention processes (Jarymowicz, Imbir, 2011). Thus, the focus here is on the specific, fundamental aspect of inhibitory control - suppressing reflexive saccades, as a form of controlling automatic visual attention reflex.

Two experiments were conducted ( $n=123$  &  $n=62$ ). A questionnaire, measuring the individual disposition toward perspective taking and an anti-saccade task, examining the ability to inhibit the reflexive eye movements, were used. Additionally, in the experimental conditions a cognitive or affective empathy, as manifestations of situational perspective taking, were activated.

The results show that (1) individuals with greater perspective taking abilities make fewer mistakes in the anti-saccade test; (2) the activation of cognitive empathy fosters the control over eye movements. Thus, perspective taking – both in its dispositional and situational aspects – appears to engage reflexive processing and require cognitive resources, responsible for inhibiting the automatic, primary response (e.g. following the more visible stimulus) and the monitoring of action, which lie within the executive functions domain. The findings contribute to both perspective taking and inhibitory control as well as to the role of executive functions in those processes.

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.. (2310) ..

**Introspection during Short-term Memory.** GABRIEL REYES<sup>1</sup> & JÉRÔME SACKUR<sup>2</sup>; <sup>1</sup>*Universidad del Desarrollo, Chile*; <sup>2</sup>*École des Hautes Études en Sciences Sociales, France*

In this talk I am going to present (and then criticize) a canon in the metacognitive literature: for many years it has been argued that introspective access to our own mental content is restricted to the cognitive states associated with the response to a task, such as the level of confidence in a decision or the estimation of response time. However, the cognitive processes that underlie such states were deemed inaccessible to participants' consciousness. Here, we endeavor to expand the range of introspective information submitted to experimental scrutiny by asking whether participants could introspectively distinguish the cognitive processes that underlie two short-term memory tasks.

To this end, we asked participants, on a trial-by-trial basis, to report the number of items they mentally scanned during their short-term memory retrieval, which we named "Subjective Number of Scanned Items" (SNSI). The SNSI index was evaluated in Experiment 1 immediately after a judgment of recency (JOR) task and in Experiment 2 after an item recognition (IR) task. Finally, in Experiment 3 both tasks were randomly mixed. The results showed that participants' introspection successfully accessed the complexity of the decisional processes.

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## Poster Session II S14, Monday, 10:40 – 12:00

.. (2401) ..

**Momentary object recognition in real and mirrored spaces.** TAKAHIKO KIMURA<sup>1</sup>, MASAMITSU MORIKAWA<sup>2</sup>, YASUNORI KINOSADA<sup>3</sup> & KAZUMITSU SHINOHARA<sup>2</sup>; <sup>1</sup>*Kansai University of Welfare Sciences, Japan*; <sup>2</sup>*Osaka University, Japan*; <sup>3</sup>*Shizuoka Institute of Science and Technology, Japan*

Although mirrors are commonly used, how the human visual system operates in mirrored spaces remains unclear. Although images in mirrored space are reversed in reference to objects in real space, humans can still acquire the necessary information. In the present study, we examined differences and similarities in object recognition between real and mirrored spaces. Twenty observers participated in the study. A black cube (18 mm per side) placed on a desk 177 cm from the observer was used as a reference point. Three conditions in terms of object numbers were used: one, three, or six objects (colored cubes) were arranged in random order within 70 cm around the reference point. A liquid crystal shutter was used to control the duration of observation (300 ms). The observers, who used a chin rest, were required to reproduce the arrangement of the objects on paper on a scale from 1 to 10 by describing only the reference point. There were two observation conditions: real and mirrored. In the real condition, the stimuli were presented in front of the observer, while in the mirrored condition, the stimuli were presented through a mirror behind the observer. The physical relationships between stimuli were identically adjusted. The nonresponse rate for six objects was increased under both the real and mirrored observation conditions; this tendency was more remarkable in the mirrored condition. The reproduced positions of the objects were analyzed when they

were relatively near or far from the actual presentation position. The results indicated that the perceived distance was more frequently overestimated in the mirrored compared with the real condition. These findings suggest that mirrored spaces exhibit some particular characteristics, for example, requiring the use of different spatial frames of reference.

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.. (2402) ..

**Mental rotation of mirror figures by changed instruction.** GUNTA KRUMINA<sup>1</sup>, JURGIS SKILTERS<sup>1</sup> & VSEVOLOD LIAKHOVETSKII<sup>2</sup>; <sup>1</sup>*University of Latvia, Latvia*; <sup>2</sup>*Pavlov Institute of Physiology of Russian Academy of Sciences, Russia*

Mental rotation of three-dimensional objects has been experimentally studied since 1971 when R.Shepard & J.Metzler found that the increase in the angle of rotation corresponds to the linear increase in reaction time for recognizing the identity of the figures. We changed instruction and asked to recognize mirror and identical figures depending on the rotation angle on the screen. We modified generated the sets of stimuli consisting of 96 2D-figures (Cooper, 1976) and 96 3D-figures (Shepard & Metzler, 1971) mirrored and identical figures rotated in 0, 60, 120, and 180 degrees. Experimental subjects were 34 students (18-27 years old) from natural sciences study program. The subjects were instructed to indicate whether the figures were mirrored or identical by pressing different buttons.

Previous studies demonstrate that 2D and 3D identical figures are recognized faster than reverse ones (i.e., mirror figures). Similarly to previous studies, our study with the new instruction (subjects should recognize and indicate the positive answer when seeing mirror figures) have the same pattern: 2D and 3D reaction times are longer for the mirrored figures. However, contrary to previous studies our results show that increase in reaction time is not linear. There are no statistical differences between the rotation of figures in 60, 120, and 180 degrees. 2D mirrored figures were recognized in  $3.7 \pm 0.3$  sec and 3D mirrored figures were recognized in  $5.5 \pm 0.6$  sec. According to our results rotation of 3D objects produced more errors, but in both cases (2D and 3D mirrored figures) there was no correlation between the rotation angle and amount of errors.

Our study shows some significant extensions in mental rotation research in explicitly asking to recognize mirrored figures. The task specificity and complexity (identity of rotated and mirrored figures might be different in terms of difficulty) more likely explains the pattern of the results.

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.. (2403) ..

**Expertise and individual differences in perception of contemporary paintings with semantic/syntactic violations.** KAROLINA PIETRAS & JOANNA GANCZAREK; *Pedagogical University of Cracow, Poland*

Introduction:

Contemporary pictorial art is often challenging for the viewer and provokes a wide spectrum of cognitive and emotional reactions that range from interest and surprise to confusion and anger. The aim of the present study is to identify the role of need for cognitive closure and expertise (both art exposure and formal curriculum) in reaction to paintings containing syntactic and semantic violations.

The hypotheses are as follows:

(1) Subjects high in need for cognitive closure and low in expertise display more negative emotional reactions to conflictual paintings in general.

(2) The reaction to semantic conflict is mediated by need for cognitive closure, whereas the reaction to syntactic conflicts relates to measures of expertise (both formal education and art exposure).

Method:

Two types of visual conflicts were investigated i.e. syntactic and semantic. Subjects viewed and evaluated four groups of contemporary paintings in randomized order (stimuli with no conflict, semantic conflict, syntactic conflict or both). Individual differences such as personality traits, need for cognitive closure as well as formal art education and self-declared art exposure were measured. Eye movements and verbal reactions to the stimuli were recorded.

Results:

The preliminary results suggest that need for cognitive closure and expertise contribute differently to emotional and cognitive reactions to semantic and syntactic violations in visual art.

Discussion:

Results indicate the role of personality traits and formal education in perception of conflict in paintings and show diversified demands which are placed on the viewers of contemporary art. Causes, limitations and future directions are discussed.

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.. (2404) ..

**Gender Perception from Faces: The Effect of Culture and Species.** MERVE BULUT & BURAK ERDENİZ; *Izmir University of Economics, Turkey*

Perception of gender from faces is one of the most important human ability for mate selection. However, there is still an ongoing debate about whether gender perception in humans is unique to human faces (domain specific) or it can be generalizable to animal faces (domain general) is de-

batable (Franklin, Zebrowitz, Fellous, & Lee, 2013). In the current study, 48 participants were asked to classify sexes of human (Caucasian and Asian) and ape (Chimpanzee and Gorilla) faces. Results showed that participants' percentage of correct classification was significantly higher than chance level for human faces but this significant effect was not found for ape faces. Additional analysis on the masculinity and femininity of the faces based on facial metrics were performed. Results revealed that brow to eye distance, nose width, lower face height and lower face width metrics had the strongest correlation with sex of Caucasian faces. Similarly, for the Asian faces; brow to eye distance, eye height and jaw height strongly correlated with sex of the faces. Unlike human faces, only the eye height and face width strongly correlated with sex for ape faces. Mean sensitivity correlations revealed that individuals' sex classification performance were strongly correlated with metrics that significantly predict sex differences in faces. This might indicate that even though sex classification performance of participants in ape faces was not significantly higher than chance level, they were sensitive to the sexually dimorphic features in ape faces. An additional eye-tracking study was conducted with 16 participants and aimed to observe participants' eye movements while they were doing the same sex classification task in the first experiment. We expect that during classification, participants will pay more attention to the sexually dimorphic features that were shown in the first experiment than non-dimorphic features. Total fixation number and duration will be compared and discussed further.

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.. (2405) ..

**Early-stage Face Processing Dysfunction in Patients with Traumatic Brain Injury: an ERP Study.** MITSUYO SHIBASAKI<sup>1</sup>, SAYOKO YAMAMOTO<sup>2</sup>, FUMIKO ANZAKI<sup>2,3</sup> & MASAKO FUJII<sup>2</sup>; <sup>1</sup>*Meisei University, Japan*; <sup>2</sup>*Non-profit Organization TBI Rehabilitation Center, Japan*; <sup>3</sup>*Yamato University, Japan*

Background: Patients with traumatic brain injury (TBI) frequently exhibit facial expression recognition deficits. However, the deficient stage of facial expression processing is unknown. To explore the nature of the deficit, we investigated early visual processing of faces in TBI patients using event-related potentials (ERP).

Method: Ten right-handed severe TBI patients who exhibited facial expression recognition deficits and 19 right-handed healthy adults participated in this study. Participants performed go/no-go tasks with upright and inverted faces or clocks (wall clocks) as target stimuli. During the tasks, electroencephalographic data were simultaneously recorded from nine scalp electrodes for ERP extrac-

tion. We examined N170, an early face-specific ERP component, which is a negative waveform peaking approximately 150–180 ms post-stimulus, to evaluate the early facial perceptual process in TBI patients.

**Results:** The healthy participants clearly showed N170 waveforms in the posterior temporal regions (T5, T6) during all the tasks, and N170 amplitudes elicited by upright and inverted faces were significantly larger than those elicited by upright and inverted clocks. In addition, N170 latencies elicited by inverted faces were significantly delayed compared with those elicited by upright faces in healthy participants. In TBI patients, N170 amplitudes in T5 and T6 were generally reduced under face and clock conditions (both upright and inverted conditions) remaining unchanged across stimulus types (faces or clocks). TBI patients did not show significant face inversion effects in N170 latencies in contrast to healthy participants.

**Discussion:** These results indicate reduction of face-specific N170 effects in TBI patients, suggesting a dysfunction of early-stage facial perceptual processing reflected by N170, e.g., structural encoding of faces (Eimer, 2000). This could potentially underlie facial expression recognition deficits in TBI patients.

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.. (2406) ..

**How late do foreign languages catch our (visual) attention?** LELA IVAZ & JON ANDONI DUÑABETIA; BCBL, Basque Center on Cognition, Brain and Language, Spain

Different studies have shown the existence of the so-called foreign language effects, i.e. a fundamental difference in the way we process information in our foreign languages as compared to our native one(s). Still, much remains unknown about where these effects stem from: the difficulty in processing foreign languages, the emotional distance they evoke, or a combination of both these factors. In a series of behavioral experiments, we used a perceptual matching and learning paradigm (i.e., the so-called “self-paradigm”) to explore the nature of the foreign language effects. However, other experimental techniques are necessary in order to better address the question of whether cognitive cost or emotional distance is at play in these effects. The eye-tracking technique in combination with the visual-world paradigm allows for the appraisal of the temporal course and the exact type of change in processing of stimuli. In the present experiment, eye-tracking enabled us to determine whether there was a qualitative or a quantitative difference in how we process information in our native vs. foreign languages. If there was a difference driven by an emotional distance, it would be observed as a

different morphology in the fixation proportions. However, if cognitive cost associated with the difficulty of processing a non-native tongue was at the source of these effects, this would manifest as a temporal delay or a shift in the timing of the effects. Our results suggest that there is no such temporal shift, but a change in the pattern of the probability of the eye-gaze fixations, such that visual attention is captured earlier in the native-language context as compared to the foreign-language one. We argue that our results are evidence in favor of the emotional distance evoked by foreign languages.

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.. (2407) ..

**The pupil's response to illusory nearness.** W. ROBBERT VAN DER MIJN & SEBASTIAAN MATHÔT; University of Groningen, Netherlands, The

The size of the pupil decreases when the eye focusses on a nearby object. Enright (1987) investigated if the near-far response similarly occurs when viewing illusory 3D images in a 2D surface. His observations of the pupillary response were “decidedly not typical”. Furthermore, it was shown that covertly shifting attention towards light or dark areas elicits a pupil response (Mathôt et al., 2013). To investigate if the pupils' near-far reflex occurs when subjects are viewing illusory 3D images on a flat 2D surface, we conducted an experiment with 30 human participants. Subjects viewed illusory 3D objects on a computer screen while we recorded pupil size with an Eyelink camera. On each trial, 2D renderings of 3D objects were shown close by and far away, on either side of the center. Subjects responded to a target line segment briefly appearing in one of the objects by indicating if the line segment tilted left or right. To direct the subject's attention to either the far-away or close-by object, an arrow appeared right before the target. In the “eyes fixed” condition subjects were instructed to not move their eyes away from the center but covertly shift their attention towards the cued object, in the “eyes free” condition they shifted their gaze. Pupils were relatively small when subjects viewed the near object in comparison to viewing the far object. However, this was only true in the “eyes free” condition. No significant difference was observed when attention was covertly directed towards near or far objects in the “eyes fixed” condition. We conclude that the pupil near-far response occurs when viewing illusory 3D objects on 2D surfaces, at least when directly looking at the objects.

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.. (2408) ..

**Information selection and task relevance in emotional and neutral images: A comparison between oculomotor behaviour and subjective judgements.** ANAÏS LEROY<sup>1</sup>, RADIA ZEGHARI<sup>1</sup>, SYLVANE FAURE<sup>1</sup> & SARA SPOTORNO<sup>2</sup>; <sup>1</sup>*Laboratoire d'Anthropologie et de Psychologie Cliniques, Cognitives et Sociales, Université Côte d'Azur, France*; <sup>2</sup>*Institute of Neuroscience and Psychology, University of Glasgow, UK*

We examined whether ocular information selection during inspection is a reliable indicator of subjective judgements of information relevance for the current task, and how the emotional content of an image affects eye-movement behaviour when it is either task relevant or irrelevant.

Two groups of 16 participants viewed 72 scenes and 72 object images, half emotional and half neutral. In each trial, they inspected one image for 4s. Subsequently, one group rated image's emotional valence on a 1 (highly negative) to 9 (highly positive) Likert scale, and then clicked with the mouse on the three locations that contributed the most to their judgement. The other group rated image's perceptual complexity on the 1-to-9 scale and clicked on the three locations they judged as the most perceptually salient. We compared oculomotor behaviour during inspection with the clicked locations, running Linear Mixed Models.

In the emotional evaluation task, clicked locations were fixated more (proportion of fixation number and time) in emotional than in neutral images, the former also showing smaller minimal distance between fixated and clicked locations and smaller entropy of fixation behaviour. No differences in these measures were found in the perceptual evaluation task. We also reported an overall difference in inspection strategy between the two tasks, with longer mean fixation duration in the perceptual evaluation task; this was found for all the images, with a greater difference in neutral images.

Our findings suggest that oculomotor selection is a reliable indicator of subjective judgement of emotionally relevant information but not of judgement of perceptual salience within the image. Moreover, they indicate that the influence of image's emotional content on eye movements is modulated by the ongoing task, reducing inspection variability when it is task relevant and decreasing the duration of information uptake during each single fixation when it is task irrelevant.

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## Poster Session II

### S15, Monday, 10:40 – 12:00

.. (2501) ..

**Arithmetic in 3-dimensional space: A closer look at the motion arithmetic compatibility effect.** SARAH MEUVE COONEY, CORINNE ASHLEY HOLMES & FIONA NEWELL; *Trinity College Dublin*

Recent studies show that spatial numerical associations extend to mental operations [1, 2], with both supported by an embodied representation of magnitude [3, 4, 5]. That is, mental calculation of addition and subtraction problems are processed more efficiently when paired with compatible movements in space, such that addition is facilitated by rightward/upward movements and subtraction is facilitated by leftward/downward movements (i.e., motion arithmetic compatibility effect) [6, 7]. In the current study, we contrast the effect of task irrelevant arm movements on mental calculation performance across three spatial dimensions – the horizontal, vertical, and sagittal planes. Specifically, we examine 6-10-year-old children and young adults' arithmetic performance when algebraic equations are performed concurrently with or without arm movements. Arms movements were aligned with the x, y, and z axes and were either congruent (i.e., addition: right/up/forward; subtraction: left/down/backwards) or incongruent with the calculation (i.e., addition: left/down/backwards; subtraction: right/up/forward). While arithmetic performance predictably increased with age, initial findings suggested that all participants were more accurate and were generally faster when arm movements were congruent with the calculation performed. Interestingly, when pitted against each other, we found no additional advantage for horizontal movements over those along the y and z axes. Compared to the spatial organization of numeric magnitudes, these findings suggest that the process of mental calculation may be more consistently oriented along the three spatial dimensions [8]. The finding that mental calculation is ameliorated with concurrent task irrelevant arm movements in school-aged children will be used to inform the design of educational technology.

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.. (2502) ..

**How do we process prices? Behavioral and electrophysiological evidence of componential analysis.** FERNANDO OJEDO<sup>1</sup> & PEDRO MACIZO<sup>1,2</sup>; <sup>1</sup>*University of Granada, Spain*; <sup>2</sup>*Mind, Brain and Behavior Research Center (CIMCYC), Spain*

The aim of this study is to demonstrate that the processing of prices (e.g., 8 euros) involved sep-

arate analysis of digit (8) and monetary category (euro). In a comparison task, a pair of prices was presented and participants selected the price with higher monetary value while event-related potentials (ERPs) were recorded. There were compatible comparisons (8 euros – 4 cents) where both the digit and the monetary category were higher in one of the prices, and incompatible comparisons (4 euros – 8 cents) where the number of one price was larger but the monetary category smaller than those of the other. Compatibility effects were observed in behavioural data with slower responses and reduced accuracy in incompatible trials than in compatible trials. Importantly, the compatibility between the digit and monetary category modulated ERP components also. A fronto-central negativity differentiated incompatible from compatible trials in the 300-400 ms time-window. Furthermore, P3 amplitudes were attenuated in compatible trials compared to incompatible trials in posterior regions. These ERP modulations due to the digit/monetary category compatibility evidenced conflict processing. Together, behavioural and electrophysiological data suggest that prices were processed in a componential manner.

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.. (2503) ..

**Spatial skills first: the importance of mental rotation skills for arithmetic skill acquisition.** CARRIE GEORGES, VÉRONIQUE CORNU & CHRISTINE SCHILTZ; *University of Luxembourg, Luxembourg*

Considering the importance of arithmetic in school curricula, it is crucial to understand the cognitive processes underlying its successful acquisition. Spatial skills seem to play an important role in arithmetic skill development. Nonetheless, while several intervention studies suggested a causal link by observing gains in arithmetic following spatial training, others failed to replicate these findings. These inconsistencies might be explained by two factors, namely developmental stage and the componential nature of arithmetic. The relation between arithmetic and spatial skills undergoes developmental changes, with spatial skills being important especially during initial arithmetic skill acquisition (Mix et al., 2016). Moreover, a developmental shift from procedural calculation to verbally-mediated fact retrieval occurs predominantly for simple additions and subtractions, as well as multiplications (Campbell & Xue, 2001). To better understand the importance of spatial skills for arithmetic, we investigated the relation between mental rotation skills and different arithmetic operations (addition, subtraction, multiplication, division, equation filling and comparison) in children attending 3rd-4th grade. At this stage, some arithmetic skills are already well-mastered (e.g.,

additions), while others are only newly acquired (e.g., multiplications). Interestingly, although mental rotation skills positively correlated with arithmetic regardless of operation (all  $p < .05$ ), spatial skills only significantly predicted multiplication ( $\beta = .28$ ,  $p = .01$ ), division ( $\beta = .29$ ,  $p = .01$ ) and equation filling performances ( $\beta = .24$ ,  $p = .05$ ) when controlling for age, basic symbolic number processing and visuospatial short-term memory in a stepwise multiple linear regression analyses. This highlights the differential effect of spatial skills on different arithmetic operations, with a particularly important role of spatial skills for the resolution of newly acquired arithmetic material. The present findings not only provide a potential explanation for previous inconsistencies regarding the relation between arithmetic and spatial skills, but also yield practical information with regard to mathematical education and instruction.

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.. (2504) ..

**An attempt to investigate the anchor point of 1/2 for fraction magnitude representations using the number line estimation task.** SAHO TANIGUCHI<sup>1</sup>, YUKI TANIDA<sup>2</sup> & MASAHICO OKAMOTO<sup>1</sup>; <sup>1</sup>*Osaka Prefecture University, Japan*; <sup>2</sup>*Osaka University, Japan*

The mechanisms for fraction magnitude representation, which is important for numerical development (Siegler, et al., 2013), have not been revealed. This study investigated the contribution of the anchor point of 1/2 to establish magnitude representations for fractions with number line estimation task. In the field of whole number research, it is suggested that anchor points contribute towards the establishment of magnitude representations, e.g., 1, 5, and 10. However, it is unclear as to what kind of anchor points contribute towards establishing of representations for fraction magnitude. We hypothesised that the anchor point of 1/2 contributes towards reducing the error distance when estimating fractions close to 1/2. However, in a typical experimental situation of the number line estimation task, the stimulus position would hinder the investigation because the stimulus number is presented above the centre of the number line, which would provide cues to participants regarding the position of 1/2. Therefore, we modified the task by moving the stimulus position to the left of the number line, and employed the typical centre presentation condition for the sake of comparison. The results showed that, contrary to our prediction, the closer the stimulus fraction was to 1/2, the larger the error distance was under both left and centre presentation conditions. This result suggested that the anchor point for 1/2 did not contribute towards establishing magnitude representations in adults. In addition, the estimation perform-

ance was poorer under the centre as compared to the left condition, although this result holds only on the first block. This result suggested that stimulus fractions presented above the centre did not facilitate the estimation of their magnitude. We will discuss these unexpected results in terms of the physical constraint of the number line estimation task and the sensitivity of the measure against strategy use.

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.. (2505) ..

**Cross-format integration between spoken number words and Arabic digits: ERPs are influenced by numerical distance.**

CHIA-YUAN LIN & SILKE M. GÖBEL; *University of York, United Kingdom*

Arabic digits and spoken number words are commonly used to communicate numerosities. This study investigated the relationship between these two codes in adults with a passive task. We recorded participants' brain responses with EEG while they completed a computerised oddball paradigm. In the auditory condition, only spoken number words were presented. During the audiovisual condition, auditory number words and visual digits were presented simultaneously. In each condition the standard was presented 400 times and the deviant 96 times. Half of the deviants were numbers with far, half with close numerical distance to the standard. Participants did not make any responses to numerical stimuli. Our analyses focused on the amplitude of mismatch negativity in the audiovisual and the auditory-only condition for investigating cross-format integration (Froyen et al. 2008), and on peak amplitudes and latencies for close and far distance numbers to investigate the numerical distance effect on ERPs. The results found no differences in MMN amplitudes between two conditions. Thus we failed to find evidence for an early integration of spoken number words and Arabic digits. However, significant differences between brain responses to close versus far distance number deviants were found in both conditions, and as early as 60 ms after stimulus onset in the auditory condition. In a follow-up study we manipulated the onset of auditory number words with respect to the onset of visual digits: the number words were presented 100 and 200 ms later than the digits. Non-parametric tests revealed no significant differences between the ERPs from different SOA conditions. These results suggest that in adults, cross-format number integration does not happen as early as letter-sound integration. However, numerical distance from the standard influences brain responses early on. Because a passive task was used, current results provide evidence for an early and automatic semantic processing of numerical symbols.

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.. (2506) ..

**Capturing the Initial Mental Representations of the Number Line.**

ANAT FELDMAN, MICHAEL SHMUELI & ANDREA BERGER; *Department of Psychology and Zlotowski Center for Neuroscience, Ben-Gurion University of the Negev, Beer Sheva, Israel*

The maturation of the representation of the mental number line (MNL) is a basic numerical skill that is predictive of later arithmetic achievements (e.g., Ashcraft & Moore, 2012). We investigated the development of the MNL during the early elementary school years using a number-to-position task on a touchscreen. This task continuously monitors the participant's finger, from the moment the target number appears on the screen to its final location on a 0-10 physical number line. We tested 118 children from the second and third grades. Results showed that at this age, children tend to underestimate small numbers and overestimate large numbers. The main difference between the second and third graders was in their placement of the number 5 and its adjacent neighbors (4 and 6). The advantage of our paradigm is that it captures the initial mental representation and cognitive processes that precede the final placement of the target number on the number line. We found that by third grade, the initial direction of the finger movement already represents the correct and final position on the number line, suggesting that the internal mental representation of the number line already aligns with the external physical number line. In contrast, second graders do not show a mature mental representation; instead, the children adjust their finger direction "on the fly" at much later stages of their trajectory. These findings shed light on the developmental process of MNL representation, providing the basis for further research on the implications of such development for the acquisition of mathematical abilities.

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.. (2507) ..

**Spatial thinking and mathematics: a developmental perspective.**

KATIE A GILLIGAN<sup>1</sup>, MICHAEL S.C THOMAS<sup>2</sup> & EMILY K FARRAN<sup>1</sup>; <sup>1</sup>*UCL, United Kingdom*; <sup>2</sup>*Birkbeck, University of London*

There is evidence to suggest that associations exist between spatial skills and Science, Technology, Engineering and Mathematics (STEM) domains. However, the majority of studies in this domain focus on university and pre-school populations with relatively little research exploring these associations in primary school children. This study combines findings from longitudinal and cross-sectional studies to highlight the importance of spatial skills as both longitudinal and concurrent predictors of mathematics in children aged 5-10 years. First, secondary data analysis of the Millennium Cohort Study, a longitudinal study of chil-



dren in the United Kingdom, indicates that spatial performance at 5 and 7 years is a significant predictor of mathematics at age 7 ( $N = 12099$ ). Spatial skills at both 5 and 7 years explained more than 15% of the variation in mathematics achievement at age 7, above that explained by other predictors of mathematics including gender, socio-economic status and ethnicity.

Secondly, cross-sectional findings also indicate associations between spatial and mathematics skills in children aged 5-10 years ( $N=156$ ). In this study, the Uttal et al., (2013) classification of spatial skills was used to generate developmental profiles of spatial cognition and its relationship with mathematics. Provisional analysis suggests that spatial skills explain approximately 10-12% of the variation in both standardised maths performance and approximate number sense, even after accounting for vocabulary skills. Spatial scaling was a significant predictor of mathematics for all age groups. Additionally, a significant role for mental rotation was found for younger children (aged 6-7 years) while a significant role for mental folding was found for older children (aged 9-10 years). These findings have implications for the design of mathematics interventions customised for specific developmental stages.

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.. (2508) ..

**Manipulating orienting of attention to understand the time course of mental calculation.** STEFANIA D'ASCENZO<sup>1</sup>, LUISA LUGLI<sup>1</sup>, ROBERTO NICOLETTI<sup>1</sup> & MARTIN H. FISCHER<sup>2</sup>; <sup>1</sup>University of Bologna, Italy; <sup>2</sup>University of Potsdam, Germany

Previous studies indicated that processing numbers induces shifts of spatial attention to the left or to the right for small or large numbers, respectively, supporting the notion of a mental number line. This spatial-numerical association has been extended to mental calculation (subtraction and addition induce left or right bias, respectively). However, the time course of activation of the spatial-numerical association during mental calculation is not clear. Here, we addressed this issue by devising a paradigm in which attention is overtly shifted on the horizontal axis by means of a moving dot during mental calculation.

In the experiment (128 trials) the magnitude of the first and the second operand (small/large), operation (addition/subtraction), result's correctness (right/wrong) and movement's direction (left/right) were manipulated. Participants were instructed to listen to each element of an operation (first operand, operator, second operand, equal and result). After each element (except for the result), a dot, presented on the screen, moved to the left or to the right and participants had to press a left or a

right button according to the dot's movement direction (4 times during each trial). A vocal response on the result's correctness was required.

Reaction times (RTs) for discriminating each movement were considered in relation to previous element(s). No evidence of early overt attentional shifts was observed (i.e., after first operand or operator) but participants' performance was modulated after the second operand: RTs were faster when the movement after the second operand was to the left and the previous operands were small, compared to when the movement was to the right. Longer RTs were observed when both operands were large and the movement was to the right.

Results suggest that attentional shifts are crucial during mental calculation, especially when there is access to all elements of the operation, confirming their functional role in mental calculation.

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## Poster Session II

### S16, Monday, 10:40 – 12:00

.. (2601) ..

**Combining the Simon task and Intentional binding task to uncover Self-control and Stimulus-driven action selection effects on the sense of agency.** YURU WANG, TOM DAMEN, MYRTHEL DOGGE & HENK AARTS; *Utrecht University, Netherlands, The*

Sense of agency refers to the feeling of causing one's own action and resulting effect. Previous research indicates that voluntary action selection is an important factor in shaping the sense of agency. Whereas the volitional nature of the sense of agency is well documented, the present study examined whether sense of agency is modulated when action selection shifts from volitional to a more automatic stimulus-driven process. Seventy-two participants performed an auditory Simon task including congruent and incongruent trials to generate automatic stimulus-driven vs. more self-control driven action, respectively. Responses in the Simon task produced a tone and sense of agency was assessed with the intentional binding task – an implicit measure of sense of agency resting on sensorimotor processes that produce a temporal contraction in perception between action and outcome as a function of intentional action selection. Results showed a strong Simon effect and a clear temporal binding effect. However, temporal binding was independent of congruency. These findings suggest that temporal binding between action and effect offers a window

to the sense of agency for both automatic stimulus-driven actions and self-controlled actions relying on volition.

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.. (2602) ..

**Action-effect related movement optimization depends on the constancy of irrelevant effect aspects.** JÁNOS HORVÁTH, BOTOND BÍRÓ & BENEC NESZMÉLYI; *Institute of Cognitive Neuroscience and Psychology, Research Centre for Natural Sciences, Hungarian Academy of Sciences, Hungary*

Numerous studies suggest that voluntary actions are encoded in terms of their effects. Recent studies show that if an action is repeated a number of times, sensory action-effects are used as feedback on the success or failure of the performed action, which allows one to find an optimum between the goal to minimize effort, and the goal to maximize the probability that an action will be successful. In recent studies, we found that in self-paced action-production tasks participants applied less force when ballistic movements or force applications consistently resulted in a sound in comparison to conditions in which no sounds were induced. The goal of the present study was to test whether such force differences reflected solely strategic decision making, or whether other, possibly more automatic processes contributed to them.

Young adult participants applied force impulses to (i.e. pinched) a force sensitive resistor in an even pace in three separate conditions. In the homogeneous condition pinches elicited the same pure tone. In the mixed condition, subsequent pinches resulted in pure tones of different frequencies. In the silent condition, no tone was elicited. As predicted, applied force was lower in both tone-eliciting conditions than in the silent condition. Importantly, applied force was also lower in the homogeneous condition than in the mixed one, which suggests that action optimization depends on the constancy of the action-effect relationship including the irrelevant aspects of the action-effect.

Because strategic decision making would depend simply on the presence of the feedback tone, but not its frequency, this suggests that beyond strategic decision making, action-effect related movement optimization also depends on, and reflects the underlying action-effect representations.

This work was supported by the Hungarian Scientific Research Fund (OTKA 108783).

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.. (2603) ..

**Effects of global and local task repetition proportion on  $n - 2$  repetition costs.** JULIANE SCHEIL & THOMAS KLEINSORGE; *Leibniz Research Centre for Working Environment and Human Factors (IfAdO), Germany*

In three experiments, the influence of task repetitions on  $n - 2$  repetition costs was investigated. Extending the experimental design of Philipp and Koch (2006) who compared no task repetitions with an overall amount of 28 % task repetitions in a within- as well as a between-subjects-design, we included an additional condition with 50 % task repetitions to investigate whether it is the occurrence of repetitions per se or the actual amount of repetitions that influences  $n - 2$  repetition costs. In addition, the amount of repetitions was varied for each task separately in a third experiment. As a result, not only the global but also the task-specific amount of task repetitions had an influence on  $n - 2$  repetition costs, which decreased with increasing amount of repetitions. This further corroborates the notion that the amount of task repetitions changes the balance of task activation and task inhibition in task switching. The effect of the task-specific amount of task repetitions on  $n - 2$  repetition costs furthermore suggests that cognitive control processes are not only shaped by the global task environment but are fine-tuned on the local task-level as a response to task-specific demands.

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.. (2604) ..

**Action-Effects Enhance Explicit Sequential Learning in an Implicit Learning Situation.** SARAH ESSER & HILDE HAIDER; *University of Cologne, Germany*

Different studies have shown that action-effect associations seem to enhance implicit learning of motor sequences. The current study aims at directly manipulating the action-effect contingencies in a Serial Reaction Time Task and examining its impact on explicit sequence knowledge. For this purpose we created a situation in which the participants' responses led to a melodic tone sequence. For one group these effect-tones were contingently bound to the sequential responses and immediately followed the key-press, for the second group the tones were delayed by 400 ms. For a third group the tones also followed the response immediately and resulted in the same melody but were not contingently bound to the responses. A fourth control group received no effect-tones at all. Only the group that experienced contingent effect-tones that directly followed the response showed an increase in explicit sequence knowledge. The results are discussed in terms of the multimodal structure of action-effect associations and the ideomotor principle of action

control.

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.. (2605) ..

**The Hard Work of Doing Nothing: Accounting for Inhibitory Costs During Multiple Action Control.**

TIM RAETTIG & LYNN HUESTEGGE; *University of Wuerzburg, Germany*

Performing many actions at the same time is usually associated with performance costs. However, recent eye tracking evidence indicates that under specific conditions, inhibiting a secondary response can be more costly than executing it, resulting in dual-action benefits. Here, we show that performance gains due to inhibitory control demands are not limited to saccades as a response modality. In our study, participants had to react to a visually presented directional word by either reading the stimulus aloud (vocal modality), pressing the corresponding arrow key on a keyboard (manual modality), or both. Crucially, manual error rates were significantly lower when participants had to respond with both a button press and naming than when they had to respond with naming only. More specifically, in naming-only conditions we observed a high percentage of false-positive manual responses, suggesting difficulties with inhibiting an unwarranted manual action. Thus, our results indicate that difficulties associated with single- (vs. dual-) action control are a stable, domain-general phenomenon which likely arises whenever executive demands are accompanied by substantial additional inhibitory control demands.

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.. (2606) ..

**Voluntary choice of modality compatibility.**

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The term modality compatibility refers to the similarity between stimulus modality and the modality of response-related sensory consequences. Previous results showed larger switch costs when participants switched between modality incompatible tasks (auditory-manual and visual-vocal) compared to modality compatible tasks (auditory-vocal and visual-manual). In the present study using a voluntary task switching paradigm, participants chose the response modality (vocal or manual) to indicate the location of either a visual or auditory stimulus. We examined whether participants show not only a modality repetition bias, but also a bias towards establishing modality compatibility. The choice probability analysis indicated that participants tend to choose the response modality

which is compatible to the stimulus modality. We found a modality repetition bias, but this bias did not differ across modality compatibility. More interestingly, even though participants freely chose the response modality, typical modality compatibility effects were still observed in task switching behaviour. The finding of modality compatibility influencing choice behaviour suggest top-down processes on the effect of modality compatibility in switch costs.

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.. (2607) ..

**Are affect-induced facial muscle contractions really under limited control? On the influence of implementation intentions.** JULIA KOZLIK<sup>1</sup> & ROLAND NEUMANN<sup>2</sup>; <sup>1</sup>*University of Greifswald, Germany*; <sup>2</sup>*University of Trier, Germany*

There is profound empirical evidence that affective states are accompanied by automatic activations of facial muscle contractions: positive affect triggers activity of the zygomaticus major, negative affect triggers activation of the corrugator supercilii. Based on findings of research on expression suppression several emotion theorists assume that humans have limited control over these affective reactions. Recent research, however, has convincingly demonstrated that certain affective reactions (i.e., approach-/avoidance-related arm movements) are significantly shapeable by implementation intentions (i.e., strategic if-then plans linking concrete behavior to certain stimuli). Based on these findings, we adopted an affective Simon procedure to test whether implementation intentions are even effective in modulating affect-induced facial muscle contractions. We observed that natural affective response tendencies are reduced to zero by mere intentions to perform affect-incongruent muscle contractions (e.g. intention to smile [frown] in response to negative [positive] stimuli) although these intentions have never been executed. These results indicate that automatic affective response tendencies are by no means under limited control but rather strategically shapeable by intentions.

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.. (2608) ..

**Intermittent but not continuous theta-burst stimulation affects working memory at low intensity.**

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Background: Theta-burst stimulation (TBS) is a

specialized form of repetitive transcranial magnetic stimulation with shorter stimulation periods resulting in longer-lasting effects. Although bilateral TBS of the dorsolateral prefrontal cortex (DLPFC) proved to be effective in reducing symptoms of affective disorders, such as major depression, cognitive effects are not well understood. The aim of our study was to test the efficiency of relatively low-intensity TBS on working memory in healthy human subjects.

**Method:** Nineteen out of 37 healthy participants were given intermittent TBS (iTBS), while 18 participants received continuous TBS (cTBS) over the right and left DLPFC. Working memory has been tested using one-back, two-back and three-back version of the n-back task both pre-and post-stimulation. Reaction times, discriminability index and response criterion have been analyzed.

**Results:** Reaction times shortened after stimulation both in the iTBS and cTBS groups. However, discriminability improved after iTBS, but was not affected by cTBS. Additionally, response criterion was reduced after iTBS showing a more liberal style of responsiveness. This also indicates that the more effective discriminability was due to the higher hit rate compared to false alarm rate. All detected effects were independent from the stimulated hemisphere.

**Discussion:** The effects of TBS on the DLPFC did not depend from side of stimulation. However, only iTBS affected n-back performance when using lower stimulation intensity. Our results implicate that low, therefore safer stimulation intensity may facilitate working memory performance, while inhibitory effects are not detectable at this intensity. These results are promising given that bilateral TBS is an effective tool in reducing depressive symptoms. Thus, the use of low-intensity bilateral TBS may even facilitate cognitive performance without causing working memory deterioration. However, further investigations investigating the effects of low-intensity TBS on patients are needed.

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.. (2609) ..

**Visual motion discrimination and the vermis: A pilot study with slow-frequency TMS.** TOMASO VECCHI<sup>1,2</sup>, CHIARA FERRARI<sup>3</sup>, VIOLA OLDRATI<sup>1,2</sup> & ZAIRA CATTANEO<sup>2,3</sup>; <sup>1</sup>University of Pavia, Italy; <sup>2</sup>National Neurological Institute C. Mondino; <sup>3</sup>University of Milano-Bicocca

A new hypothesis suggesting a possible role of the cerebellum in coordinating sensory data in the motor domain and in the cognitive domain has been proposed. However, inconsistent evidence exists relatively to the topographic contribution of the cerebellum to this function, with some lesion and neuroimaging studies pointing to the midline struc-

tures but not to cerebellar hemispheres and others pointing also to the lateral parts of the cerebellum as crucial in underpinning motion discrimination. A recent study showed participants' impaired performance in identifying the direction of moving dots while transcranial magnetic stimulation (TMS) was delivered over the vermis but not while TMS was delivered over the hemispheres. The aim of the present study is to extend prior evidence relative to the contribution of the vermis to motion perception processes, by employing more complex stimuli, including dots moving on the horizontal axis (leftward and rightward) and dots moving on the vertical axis (downward and upward). We asked participants to performed a motion discrimination task before and after receiving TMS over the vermis, V1 and a control condition (vertex). We found that TMS applied over the vermis significantly impaired participants' performance, similarly to TMS over V1, corroborating previous findings on the causal role of the vermis in motion perception. Moreover, the detrimental effects of TMS over the cerebellum were comparable when dots moved on the horizontal axis and on the vertical axis. Results are discussed in light of sensory integration mechanisms possibly contributing to this phenomenon. Finally, our findings support the possible employment of TMS as a tool to promote changes in the brain activity paralleled by behavioral modifications able to overcome the exact time of the stimulation.

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.. (2610) ..

**The role of the dorsolateral prefrontal cortex in the motor placebo effect: a tDCS study.** BERNARDO VILLA SÁNCHEZ, MEHRAN EMADI ANDANI & MIRTA FIORIO; *Department of Neurosciences, Biomedicine and Movement Sciences, University of Verona, Italy*

Knowledge on the brain regions involved in the motor placebo effect is still scant. Some evidence hints at the involvement of the primary motor cortex, but whether other brain areas are involved is unknown. One key area in the placebo effect is the dorsolateral prefrontal cortex (DLPFC), which is involved in higher-order cognitive functions and in placebo-induced analgesia as well. To investigate the role of this area in the motor placebo effect, transcranial direct current stimulation (tDCS) was applied over the left DLPFC during a placebo procedure.

In a first experiment, nineteen healthy volunteers performed a motor task by pressing as strongly as possible a piston with the right index finger. We applied transcutaneous electrical nerve stimulation (TENS) as an inert treatment to the first dorsal interosseous while, subjects were informed that this treatment would induce force enhance-

ment. Moreover, subjects were conditioned about the effects of TENS with a surreptitious increase of the visual feedback signaling the level of force. In a second experiment, thirty-two other healthy volunteers performed the same motor task, but without conditioning. In both experiments, subjects received anodal, cathodal and sham stimulation during the motor placebo procedure.

We found stronger force levels at the end of the placebo procedure in both experiments. This confirms that the paradigm was suitable to induce motor placebo effect. However, the type of tDCS stimulation did not modify the force level. By restricting the analysis only to placebo responders (i.e., subjects who had a force enhancement in the final session during sham stimulation), we found that anodal and cathodal tDCS reduced the placebo response, only in experiment two.

It appears that independently of the polarity, tDCS over the left DLPFC could disturb the motor placebo effect in those subjects who were treated without conditioning.

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.. (2611) ..

**Neural oscillations involved in Face and Body Inversion Effects.** FRANCESCO BOSSI<sup>1,2,3</sup>, DAVIDE RIVOLTA<sup>3</sup>, SARA PIZZAMIGLIO<sup>3</sup>, SEMA BALABAN<sup>3</sup>, MARCELLO GALLUCCI<sup>1,2</sup> & PAOLA RICCIARDELLI<sup>1,2</sup>; <sup>1</sup>University of Milano-Bicocca, Department of Psychology, Italy; <sup>2</sup>NeuroMI: Milan Center for Neuroscience, Italy; <sup>3</sup>University of East London, School of Psychology, United Kingdom

The perception of faces and bodies is mediated by holistic mechanisms, which allow the perception of these two categories of visual stimuli as a whole. Holistic mechanisms are not available for the perception of upside-down faces (Face Inversion Effect; FIE; Yin, 1969) and bodies (Body Inversion Effect; BIE; Reed et al., 2003). The neurophysiological mechanisms that mediate these behavioural effects are still largely unexplored. Thus, in the current study we investigated neural oscillations associated to upright and inverted visual stimuli.

While wearing a 128 electrodes high-density EEG cap, participants were asked to process different features (i.e., orientation, gender, emotional expression) of upright and inverted faces and bodies (houses were also shown as a control category). Specific patterns of activity were found over occipitotemporal and frontal regions in relation to FIE and BIE: participants revealed amplified gamma-band activity and stronger alpha suppression in response to upright compared to inverted faces and bodies, but not for houses. In addition, emotional stimuli induced greater theta and gamma activity only in the upright orientation. Our results demonstrate that face and body perception share behav-

oural and neurophysiological similarities, and thus have important implications for the understanding of the neurophysiological bases of visual cognition. Email: f.bossi3@campus.unimib.it

.. (2612) ..

**Slow-down age-related deficit in elderly : What about social, cognitive, and physical stimulation ?** CLÉMENCE JOUBERT & HANNA CHAINAY; *Université Lyon 2 - Laboratoire d'Etude des Mécanismes Cognitifs, France*

Background : Facing a growing aging population, more and more non-pharmacological methods emerge from the scientific literature, and are said to slow down the age-related cognitive decline. A triad of treatments are supposed to have a positive impact on cognition : social, cognitive, and physical stimulation. In the present study we aimed to investigate the impact of each of these 3 kinds of stimulation on the age-related cognitive decline.

Method : 4 groups were designed : Control non-active (i.e. no activity at all) vs Control cognitively active (i.e. discussions and documentary) vs Control physically active (i.e. regular physical activity practiced in autonomy) vs Cognitive training group (i.e. working memory and executive functions training). Training took place during 8 weeks, 1 hour 2 times per week. We measured executive functioning, and especially flexibility, task switching, visual attention, inhibition, updating and speed processing.

Results : All groups showed improvements on speed processing. However, only Cognitive training and Control physically active groups presented improvements on trained tasks scores. Indeed, both Cognitive training and Control Physically active groups showed increasing results at post-test for working memory, visual attention and inhibition. Only control cognitively active group showed reduced depression score.

Discussion : In this study, we first showed the positive impact of cognitive and physical stimulation on working memory, visual attention and inhibition in aging, as compared to control groups. Secondly, the fact that control cognitively active group was the only one to show reduced depression scores can be linked to the fact that this is the only group in which there were group interactions and discussions. Thus, these results suggest that social intervention can be involved in depression reduction. This study put in evidence the efficiency and the importance of the cognitive, physical and social intervention in the slowing of age-related cognitive decline.

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.. (2613) ..

**Impact of knowledge about the speaker on irony understanding: Evidence from ERPs and neural oscillations.**

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In everyday life, non-literal language (e.g. irony) understanding requires the integration of linguistic information with extra-linguistic information by the listener. Such extra-linguistic information may be about the speaker. Indeed, speaker occupation stereotypes have been demonstrated to be social knowledge that cue speaker ironic intent (Pexman & Olineck, 2002). The aim of the present study was to investigate when and how linguistic information and extra-linguistic information about the speaker (i.e. type of speaker occupation) are integrated during irony comprehension.

To this aim, we recorded EEG during a task of irony comprehension in which contextual information was manipulated according to the presence of a speaker occupation cueing or not ironic intent. Twenty three native French speakers were asked to read stories displayed in 2 context condition (ironic, literal) x 3 speaker occupation condition (sarcastic occupation, non sarcastic occupation, no occupation). ERP analysis and time frequency analysis were performed according to these conditions.

The main results showed that a larger P200 (150-250ms) component was evoked when the speaker occupation was congruent with the sentence interpretation (i.e. ironic statement uttered by a speaker with a sarcastic occupation). A larger P600 (500-800ms) component was evoked for the ironic statements compared to the literal statements whatever the speaker occupation. This irony related P600 component compared to literal statement was congruent with previous studies on irony. These results partially confirmed those of Regel et al. (2010) showing that this knowledge affects irony understanding both in the earlier and the later stages of comprehension. Time frequency analyses revealed a significantly greater desynchronisation in the alpha band over a later time window for the ironic condition compared to the literal condition, accompanied by a significantly greater synchronisation in the theta band. We also observed a more robust alpha band desynchronisation when the speaker occupation was incongruent with the sentence interpretation.

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.. (2614) ..

**Integration of congruency effect and conflict adaptation in the overt naming stroop task : behavioral and ERP investigation.**

ERIC MÉNÉTRÉ, RAPHAËL FARGIER & MARINA LAGANARO; *University of Geneva, Switzerland*

The Stroop task has been intensively studied in two different and separate ways. The classical Stroop congruency effect corresponds to increased production latencies when color words are written in an incongruent ink color. A more recent focus on the Stroop task is related to the conflict adaptation theory. This theory predicts that reaction times are slowed down when the previous item belongs to a different condition than the current one. In addition, regardless of the current trial condition, items preceded by an incongruent trial are also slower. Studies investigating the conflict adaptation effect did not use neutral conditions and are restricted to manual responses, whereas those analyzing the congruency effect have made use of a neutral condition and of verbal responses. This study aims at bringing some insights into the mutual interactions between the congruency and conflict adaptation effects, through behavioral and ERP investigations. 16 young adults performed a mixed design Stroop task including congruent, incongruent and neutral conditions (colored symbols) with overt verbal responses and EEG/ERP recording. Preliminary results replicate the classical Stroop congruency effect (longer production latencies for incongruent trials relative to congruent trials). Also, production latencies were significantly longer when the current item was preceded by an incongruent trial compared to a preceding congruent and neutral trial. However, the switch trials between conditions were not slowed down in all switch comparisons, indeed this is not the case for the comparison incongruent-neutral versus congruent-neutral and. These results suggest that in an overt naming Stroop task there is no pure switch effect nor pure attentional effect, but conflict adaptation and linguistic congruency effects are mutually modulated. ERP will further inform on the loci of the integration of those two effects.

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## Poster Session II

### S17, Monday, 10:40 – 12:00

.. (2701) ..

**Opposite dual-task effects in attention or inhibition tasks and speech.** MARYLL FOURNET<sup>1,2</sup>, MICHAELA PERNON<sup>3,4</sup>, SABINA CATALANO CHIUVE<sup>2</sup>, URSULA LOPEZ<sup>2</sup> & MARINA LAGANARO<sup>1</sup>; <sup>1</sup>University of Geneva, Switzerland; <sup>2</sup>Geneva University Hospital, Switzerland; <sup>3</sup>Hôpital Lariboisière, France; <sup>4</sup>National Center of Scientific Research, France

Resource allocation in cognitive dual-task paradigms is mainly conceived as a flexible process, as various aspects can influence task prioritisation (for example, Kemper et al, 2011). However, the mechanisms in charge of this process is not fully understood (Wickens, 2008), with a few number of studies having explored the bidirectional effects of each task on the other one (Bailey & Dromey, 2015). A smaller number used several non-verbal cognitive concurrent tasks to test differential effects on verbal performance. Here we investigate the effect of two non-verbal concurrent tasks on speech performance and vice versa.

61 healthy adults performed a dual-task paradigm involving a semi-automatic language task (loop recitation of days of the week) with an attentional (manually respond to a shape visually presented) and an inhibition (manually respond to one shape upon two possibilities) concurrent task. Each task was realised in simple and dual-condition, allowing interference indexes to be calculated for all tasks. Two scores were used to measure verbal performance : global speech rate (number of words / production time), articulation speech rate (number of syllables in each « Wednesday-Thursday » / production time) and one score for non-verbal performance (reaction time for correct responses).

Results indicate that speech rate is significantly more interfered by the concurrent inhibition task than by the attentional one. On the contrary, reaction time interference index by concurrent speech is significantly worst in the attentional task than in the inhibition task.

These results are in line with the conception of flexible resource allocation : more resources seem to be attributed to the verbal task during the attentional task but less during the inhibition task. Each non-verbal task having used the same instructions, we suggest that some other aspects, potentially related to type/cost of cognitive processing could modulate dual-task interference effects between verbal and non-verbal tasks.

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.. (2702) ..

**Association of ADHD symptoms with Stroop-like interference in the animal size tests.** YOSHIFUMI IKEDA<sup>1</sup>, KOICHI HAISHI<sup>2</sup>, SHIGEJI OBA<sup>1</sup>, TAKE-SHI YASHIMA<sup>1</sup> & HIDEYUKI OKUZUMI<sup>3</sup>; <sup>1</sup>Joetsu University of Education, Special Needs Education, Japan; <sup>2</sup>Saitama University, Special Needs Education, Japan; <sup>3</sup>Tokyo Gakuji University, Special Needs Education, Japan

In the animal size tests, participants are presented with pictures of animals (large animals such as an elephant vs. small animals such as a frog) printed as either big or small images that are mismatched with the animal's real size. Participants must decide the size of the animals (big vs. small) based either on the size in real life (the real animal size test) or the size of the picture (the pictorial animal size test), resisting interference of irrelevant sizes in real life or in a picture. Previous research demonstrated larger interference in the pictorial animal size test than in the real animal size test. However, it remains unclear whether the interference was affected by an absence of task conflict as well as whether the interference relates to behavioral problems. First, adults were administered the pictorial animal size test while we manipulated prevalence/absence of task conflict for stimuli in the control condition (middle-sized animals vs. black squares). We found that the interference score increased dramatically when calculated with RT of the control condition that did not involve task conflict (i.e., black squares). Next, we investigated whether the interferences be related with behavioral problems assessed with ADHD rating scale. The results showed that ADHD symptoms were not related with the interference in the real animal size test but with that in the pictorial animal size test. These findings suggest that the pictorial animal size test demands cognitive control with which individuals with higher ADHD tendency have weakness.

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.. (2703) ..

**Allocating attention towards fearful faces – do physical distance or gender influence attention?** AIMEE BECKY MARTIN, STEFANIE I BECKER & ALAN J PEGNA; *The University of Queensland, Australia*

Attention plays a vital role in selecting stimuli for further processing and seems to be especially sensitive to stimuli that signal danger. For instance, a snake may be attended to earlier than a kitten, and angry or fearful faces may be attended to earlier than happy faces because quickly orienting to imminent threats confers an advantage for survival. Recently, fMRI studies have found that threatening stimuli such as spiders enhance brain activity in

fear-relevant areas when they are situated closer to the subject. However, it is unknown how physical distance modulates cerebral processing in response to emotional faces.

The present study investigated whether attentional capture by fearful faces is modified by the physical proximity from the viewer. EEG/ERP measures were recorded in healthy participants and the N2pc component (an electrophysiological marker of attention) was measured for fearful and neutral faces. Viewing distance was varied systematically with faces appearing either within peripersonal space (50cm) or in extrapersonal space (120cm). Participants were asked to judge whether the faces were of the same gender or not. Preliminary results reveal a larger N2pc component when fearful expressions appear in extrapersonal compared to peripersonal space. In addition, gender appears to play an important role in the allocation of attention. A larger N2pc was found for fearful female faces in the presence of neutral males and the negativity was larger in peripersonal compared to extrapersonal space. This suggests that the distance between the viewer and the stimulus impacts attention but that processing is also modulated by the gender and emotional valence of the face.

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.. (2704) ..

**Transcutaneous vagus nerve stimulation modulates attentional allocation processes: an ERP study.** CARLOS VENTURA BORT<sup>1</sup>, HANNAH GENHEIMER<sup>2</sup>, JANINE WIRKNER<sup>3</sup>, JULIA WENDT<sup>3</sup>, ALFONS O. HAMM<sup>3</sup> & MATHIAS WEYMAR<sup>1</sup>; <sup>1</sup>University of Potsdam, Germany; <sup>2</sup>University of Würzburg, Germany; <sup>3</sup>University of Greifswald, Germany

Recent research suggests that the P300 may be closely related to the activation of the locus coeruleus-norepinephrine (LC-NE) system. To test this relationship, we applied transcutaneous vagus nerve stimulation (tVNS) while participants performed an oddball task. Using a within-subject design, 20 healthy participants received continuous tVNS and sham stimulation on two consecutive days (stimulation counterbalanced across participants). During stimulation, oval non-targets, normal-head (easy discrimination) and rotated-head (hard discrimination) targets were presented (see Begleiter et al., 1984). As a marker of noradrenergic activation, we collected salivary alpha-amylase (sAA) before and after stimulation. We found that tVNS successfully activated the noradrenergic system, as indicated by an increase of sAA. Interestingly, larger P300 amplitudes to targets, relative to standards, were observed during active tVNS, compared to sham stimulation, and only for the easy but not hard targets. Critically, the P300 increase was associated with stronger sAA activation

after tVNS, but not after sham stimulation. Our results support the assumption that, at least under low cognitive load, the P300 is modulated by tVNS via the noradrenergic system. Future research is needed to investigate whether tVNS also facilitates other processes, such as learning and memory.

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.. (2705) ..

**Recent response conflict reduces perceptual sensitivity at the time of distractor onset.** MICHAEL SPRENGEL<sup>1</sup>, MIKE WENDT<sup>2</sup> & THOMAS JACOBSEN<sup>1</sup>; <sup>1</sup>Helmut Schmidt University / University of the Federal Armed Forces Hamburg, Germany; <sup>2</sup>Medical School Hamburg, Germany

In experimental conflict protocols, participants typically respond more slowly and less accurately when, on any given trial, the prescribed stimulus-response mappings for target and distractor(s) are incongruent (i.e. contradictory) than when they are congruent. Suggestive of strategic optimization, this interference effect is smaller when such response conflict is frequent or recent. Wendt, Luna-Rodriguez and Jacobsen recently (2014) provided electro-physiological evidence that, in the former case of frequent conflict, this is achieved through a down-regulation of distractor processing at an early perceptual level. However, the reliability of their behavioral correlate was compromised. To remedy this shortcoming in the investigation of interference modulation by recent conflict we introduced perceptual discrimination 'probes' into a temporal flanker protocol employing coherent motion stimuli:

In 11% of the trials, an only weakly coherent motion episode surprisingly occurred instead of the fully coherent distractor motion, that preceded the fully coherent target motion in the remaining 89% of the trials. We expected discrimination of the weakly coherent probes to be less accurate after incongruent trials than after congruent trials. Beyond this immediate sequence effect, we expected the penultimate trial's congruency to influence discrimination performance in the same way. While the first hypothesis could not be substantiated, discrimination performance did suffer when the penultimate trial was incongruent as opposed to congruent. Fittingly, the penultimate trial's congruency also modulated the main interference effect more strongly than the immediately preceding trial's congruency did.

We speculate that this apparent retardation is due to the difficulty of influencing the perception of basic features top-down. Clearly, our findings do not warrant an explanation of direct sequential interference modulations in terms of attentional adjustments. They do, however, represent the first unequivocal case of a strictly perceptual change fol-



lowing so called response conflict - in the expected direction.

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.. (2706) ..

**Deviance distraction, working memory capacity (WMC) and response inhibition: a cross-sectional study.** ALICIA LEIVA, PILAR ANDRÉS & FABRICE B. R. PARMENTIER; *University of the Balearic Islands, Spain*

Background: Unexpected changes in a train of otherwise repeated task-irrelevant sounds (deviant among standard sounds) capture attention and lengthen response times to visual targets (deviance distraction). Performance in WMC tasks, the ability to inhibit a response and the ability to ignore irrelevant stimuli have been argued to exhibit similar developmental trajectories, increasing from childhood to adulthood and decreasing in older age. We aimed to explore whether differences in deviance distraction across age groups could be due to differences in WMC or response inhibition.

Method: 39 children (M age = 8.4), 44 young adults (M age = 20.7), and 39 older adults (M age = 64.7) performed a cross-modal oddball task, stop-signal task and a WMC task.

Results: We carried out a linear regression analysis with age group, WMC and SSRT as independent variables and distraction (RTs deviant minus standard) as the dependent variable. Age group contributed significantly to the model's fit but WMC or the inhibition measure (SSRT) did not. Partial correlations revealed no correlation between deviance distraction and SSRT in any of the age groups when controlling for WMC. When controlling for SSRT, we found a negative correlation between deviance distraction and WMC in older adults, a positive one in children, and no correlation in young adults.

Discussion: Response inhibition did not exhibit any relationship with deviance distraction in any of the three age groups. There is no consistent link between WMC and deviance distraction across the three age groups (children, young and older adults).

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.. (2707) ..

**Visual working memory load delays attentional target selection: Evidence from the N2pc component.** NICK BERGGREN & MARTIN EIMER; *Birkbeck University of London, United Kingdom*

Top-down task-sets (attentional templates) guide attentional selection during visual search. While prominent models of attention posit that such templates are maintained within visual working memory (vWM), it has been difficult to demon-

strate that demands on vWM adversely affect visual search efficiency. Costs of increasing vWM load on search performance have been found only in tasks where search templates change on a trial-by-trial basis (Woodman, Luck, & Schall, 2007). Here, we investigated links between vWM load and the efficiency of target selection in visual search with electrophysiological measures. Participants first memorised one or four visual items, and then unpredictably received either an immediate memory test or a visual search display where targets were defined by one of two possible colours. Target colours in the search task changed between each block (Experiment 1 & 2A) or were constant across blocks (Experiment 2B). In all experiments, the selection of target objects in the search displays (as reflected by N2pc components to these objects) was delayed under high versus low vWM load. This provides, to our knowledge, the first electrophysiological evidence for the claim that vWM is intrinsically involved in efficient maintenance of attentional templates for target features, even in situations where such templates remain constant over time.

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.. (2708) ..

**A Cost-Benefit Mechanism Underlying Task Selections in Reward-Based Voluntary Task Switching (rVTS)** DAVID BRAUN<sup>1</sup> & CATHERINE ARINGTON<sup>1,2</sup>; <sup>1</sup>*Lehigh University, United States of America*; <sup>2</sup>*National Science Foundation, United States of America*

How do people make sequential selections between tasks in cognitively-demanding, multi-task environments? Emerging perspectives on this question consider task selections in these contexts as the result of a mechanism that integrates benefits and costs for tasks into single representations that are compared to make selections (Shenhav, Botvinick, & Cohen, 2013). Our previous work has found support for this perspective using a reward-based voluntary task switching (rVTS) paradigm where participants must avoid time costs and pursue rewards while selecting between simple tasks. The present studies investigated how such a cost-benefit mechanism might process reward by varying processing difficulty of the reward information. Participants performed rVTS by choosing between two simple judgment tasks, performed on bivalent stimuli and given the global instructions to accrue 500 points as quickly as possible. In Experiment 1, task values for each potential task appeared prior to the stimulus as digits presented to the left and right of fixation and randomly varying between one and ten on each trial. Experiment 2 increased the salience of the difference between task values by varying the font color of the task value as a func-

tion of the magnitude of difference between values. Task selections in Experiment 1 showed a step function sensitive to direction, but not magnitude of the difference in task values, suggesting that task selections relied on categorical judgments of reward rather than comparisons of specific reward values. Experiment 2 supported this interpretation by revealing that task selections were sensitive to changes in the magnitude of difference only when the font colors indicated the difference. These results suggest that – when under time pressure – deployment of cognitive control is driven by relatively superficial features of a reward environment. Whether such behavior reflects a bug or feature of decision-making mechanisms remains an open question.

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.. (2709) ..

**Can we like Stroop stimuli?** RADOŚLAW STERCZYŃSKI, ANNA SIEJEK & ALINA KOLAŃCZYK; *University of Social Sciences and Humanities, Faculty in Sopot, Poland*

The aim of our study was to verify if mindset evoked by task can modify cognitive and affective reactions. In experiment 1 we compare Stroop colour-words processing in Stroop-like task (ink colour categorisation) vs. the same stimuli processing in lexical decision task (word-nonword categorisation). In line with Schmidt, Cheesman, & Besner (2013), Stroop interference occurred vividly only in the colour identification condition. In lexical decision task participants reacted equally fast to congruent and incongruent colour names. To trace affective consequences of stimuli expositions, in experiment 2 we changed response tool from keyboard into joystick lever. Basing on approach avoidance effect (Solarz, 1960, Phaf, Mohr, Rotteveel & Wicherts, 2014) we assumed that the affect induced by stimuli determines lever pulling and pushing reaction times. The results confirmed the previously observed differences in absolute reaction times to congruent and incongruent colour names between colour identification and lexical decision tasks. Against our expectations, movement direction RT analysis did not reveal any significant differences between tasks. Neither in Stroop task nor in lexical decisions pulling and pushing latencies differentiates congruent and incongruent stimuli. However there are some doubts rose around the approach-avoidance measure of affective valence. The results may be interpreted as an evidence for influence of task on cognitive processing determining specific reactions and relatively low influence of task on less specific affective reactions.

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.. (2710) ..

**Attentional Networks during the Menstrual Cycle.** ZAHIRA ZIVA COHEN<sup>1</sup>, OFFER EREZ<sup>1,2</sup>, ARNON WIZNITZER<sup>1,2</sup>, LEE KOREN<sup>3</sup> & AVISHAI HENIK<sup>1</sup>; <sup>1</sup>*Ben-Gurion University of the Negev, Israel*; <sup>2</sup>*Soroka University Medical Center, Israel*; <sup>3</sup>*Bar-Ilan University, Israel*

The menstrual cycle is characterized partially by fluctuations of the ovarian hormones estradiol and progesterone. These hormones are known to influence neurotransmitters implicated in the regulation of cognition and affect, including acetylcholine, serotonin, dopamine, and norepinephrine. These neurotransmitters are involved in the three attentional networks of alerting, orienting, and executive function. Research on attention and the menstrual cycle is sparse and to the best of our knowledge, there is no study that explored the interaction of the menstrual cycle with the mentioned three networks. In our study, we used the ANT-I (attentional network test – interactions). We examined two groups of women: natural – those with a regular menstrual cycle, and controls – those using oral contraceptives and characterized with a low and steady ovarian state. We tested their performance at two time points; pre-ovulation – 4th day – follicular phase, and post-ovulation – 18th day – mid-luteal phase of the menstrual cycle. There were no differences in performance between controls and natural women in low ovarian hormone states (i.e., pre and post ovulation for controls and pre-ovulation for natural group); performance in the ANT-I replicated all known main effects and interactions. However, among the natural group in post-ovulation, the alerting system was activated even without an alerting tone, probably due to the level of estrogen and progesterone and their interaction with neurotransmitters and brain areas involved in attention.

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.. (2711) ..

**The role of explicit instructions about target features for top-down control settings in contingent capture.** TOBIAS SCHÖBERL & ULRICH ANSORGE; *University of Vienna, Austria*

In top-down contingent capture experiments, cues similar to targets capture attention and cues dissimilar to targets do not capture attention. For example, when searching for green targets, a target-preceding green cue at target position facilitates search in comparison to a green cue away from target position, but this cueing effect is not observed for red cues. Especially if cues are not informative of the target's position, this selective cueing effect of target-similar cues is interpreted as top-down contingent capture by the cues: evidence for the participant's inadvertent application of their target-

directed top-down search settings to the cues. Typically, explicit instructions inform the participants about to be searched-for target features. Yet, recent evidence shows that learning also plays a role. We therefore tested to which extent top-down settings depended on explicit instructions about target features and to which extent top-down settings were influenced by target-signaling features not pointed out in the instructions. In each trial, the searched-for target had one out of two possible colors and a specific shape so that participants could search for color or for shape. In Experiment 1, instructions informed about the target's colors. In Experiment 2, instructions informed about the target's shape. In both experiments, the cue's color was similar or dissimilar to a target color, and the cue's shape was similar or dissimilar to the target's shape. Results showed that top-down settings were mostly determined by instructions: Cueing effects were restricted to target-similar cues and largest for cues similar to explicitly instructed target features. Yet, during search for shape targets, cues with target-similar colors captured attention, albeit to a lesser extent than cues with target-similar shapes. This result shows that at least target colors were learned and integrated into the top-down settings when participants were instructed to search for shape.

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.. (2712) ..

**Attentional Inertia: Persistence of top-down search settings due to poor inhibitory control.** CATHERINE THOMPSON<sup>1</sup>, ALESSIA PASQUINI<sup>1</sup> & PETER HILLS<sup>2</sup>; <sup>1</sup>University of Salford, United Kingdom; <sup>2</sup>Bournemouth University, United Kingdom

Visual attention is allocated to specific information on the basis of task demands. This ensures processing of relevant information and inhibition of irrelevant information. A change in task should be accompanied by a change to these top-down attentional settings, yet studies show this does not always occur, and an attentional set can persist from one task to another. The magnitude of this attentional inertia effect has been found to vary and an experiment was conducted to investigate whether this is due to the difficulty inhibiting previously relevant settings or establishing new settings. Forty participants searched through letters presented horizontally, vertically, or randomly. They then rated the complexity of three types of images that were designed to vary in top-down demand: road scenes (high demand), nature scenes (medium demand), and fractals (low demand). A horizontal letter search increased horizontal scanning and decreased vertical scanning in the image task providing evidence for attentional inertia. This effect did not vary across the three image types suggesting that persistence of an attentional set is due to a

failure to inhibit previously relevant top-down settings. The findings indicate that attentional inertia may have real-world implications given that the semantic content of a task has no influence on the effect.

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.. (2713) ..

**The effect of cognitive trainings of executive functions on perceptual processing speed.** JAROSŁAW ORZECZOWSKI, HANNA BEDNAREK, MAGDALENA PRZEDNICZEK, RAFAŁ SZEWCZYK, JUSTYNA OLSZEWSKA & MICHAŁ ZIEMBOWICZ; *SWPS University of Social Sciences and Humanities, Poland*

In spite of a large body of empirical research demonstrating the importance of computerised cognitive trainings (CCT) there is still an ongoing debate whether these trainings are effective or not. In this study we investigated whether an intensive training of executive functions improves perceptual processing speed. 123 subjects, aged 19-31 ( $M=23.33$ ,  $SD=2.65$ ), participated in the pre- and post-test with the Inspection Time Test (ITT) to measure their perceptual processing speed and with a set of commonly used measures of working memory and attentional system. Two groups, experimental ( $N=61$ , 52.7% female) and control ( $N=63$ , 48.2% female), completed 18 training sessions (40 min/day). Each training consisted of three practise-tasks that are considered to improve updating, inhibition, and switching functions. The experimental group were trained on an adaptive version of these tasks, while the control group completed a non-adaptive placebo training. We found that despite of significantly worse performance in the ITT in the experimental group during pre-test, adaptive training eliminated these differences in the post-test. Both groups improved their processing speed after the training, however, the effect size was greater in the experimental group. No higher-order executive functions were affected by the training. Taken together, the results support the idea that an intensive CCT leads to improvement of basic perceptual processing speed, but has no effect on higher-order cognitive functions.

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.. (2714) ..

**High levels of subjective arousal lead to the inability of making good choices.** NORIKO ONOMA<sup>1</sup>, YASUHIRO KITAMURA<sup>1</sup>, RIN HANADA<sup>2</sup> & TSUNEYUKI ABE<sup>2</sup>; <sup>1</sup>Railway Technical Research Institute, Japan; <sup>2</sup>Tohoku University, Japan

The somatic marker hypothesis (SMH) proposed by Damasio is not always reproduced in skin conductance responses (SCRs). Ohira (2014) indicated

that in 39 papers were associated with the reproduction of the knowledge, only 4 papers measured SCRs. SCRs, are generally used as an index of arousal level, have a complex physiological mechanism, and reflect not only a psychological mechanism but also a bodily independent difference. Therefore, we measured subjective arousal levels, in which a bodily independent difference hardly appears, and investigated SMH. As Bechara et al. (1996) insisted, if SCRs indicating arousal level verifies SMH, the responses to a questionnaire measuring subjective arousal levels should also verify SMH; we hypothesized that increasing subjective arousal levels influences the participants to choose the good decks continuously from the early trials. In comparing the results between the choice behaviors in IGT and anticipatory SCRs, and also between the choice behaviors in IGT and subjective arousal levels, as the previous studies, we could not reproduce that anticipatory SCRs were generated prior to choosing the bad deck. In this study, opposite to our expectation, a positive correlation was observed between the subjective arousal levels and lateness of the number of trials from which the participants started to choose the good deck. These findings suggest that the high subjective arousal impaired conscious knowledge of the expected value of the participants, or even if the participants could be conscious of knowledge of the expected value, the participants with high subjective arousal were likely to choose the bad decks intentionally.

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.. (2715) ..

**Which is the eldest beetle on the planet beetle paradise? Cue-discovery in social and individual learning.** INGRID MANTHEI; *Alpen-Adria Universität Klagenfurt, Austria*

The study aims to answer whether people achieve better performance in groups than individual when it comes to decision making in cue-discovery. Cue-discovery is a significant part of learning from experience in natural environments. People can use feedback to identify relevant cues and learn to eliminate irrelevant cues. Interestingly is that cue-discovery hasn't been examined in group-decision making, only in situation with individual learner (Klayman, 1984). Another question of attention is can people create a cue-order from the most relevant to least relevant cue? Garcia-Retamero, Takezawa and Gigerenzer (2009) demonstrated that social exchange can greatly speed up cue-hierarchy learning in probabilistic inference tasks such as staff selection.

My study investigates 84 participants (42 persons in an individual setting and 42 in group decision setting) with a process-oriented method

(learning game) on a computer. The participants will be shown 24 fictitious beetles (each beetle has six cues with two features) and they have to find the eldest beetle by comparing them. Participants have the possibility to create their own learning environment. In the first step the participants have to learn which cues are relevant and which are not (cue-discovery). In the second step they have to rank the cues according to the relevance of cue-validity (cue-hierarchy learning). The only difference between the two settings (individual-learner and groups) is that the social group will have the possibility of discussing their decisions-strategies.

It is expected that social-groups will benefit from the social exchange and therefore decide more accurate in the trials than individual learners. Therefore, it is assumed that social groups need also fewer decision-trials in cue-discovery and cue-hierarchy learning in probabilistic environments. The results will be presented for discussion.

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.. (2716) ..

**Self-other decision making in the context of ultimatum bargaining.** JANNA KATRIN RÜSSMANN<sup>1</sup> & SASCHA TOPOLINSKI<sup>2</sup>; <sup>1</sup>*University of Würzburg, Germany*; <sup>2</sup>*University of Cologne, Germany*

Whenever individuals decide about a certain matter not for themselves but for another person, they are engaging in proxy decision making. A growing body of literature suggest that proxy deciders differ systematically from personal decision makers (Kray, 2000; Polman, 2010; Polman, 2012; Zikmund-Fisher, Sarr, Fagerlin, & Ubel, 2006; Lu, Xie, & Xu, 2012).

However, none of these approaches investigates how proxy deciders vary in economic bargaining situations. The present research identifies outcome differences that arise if individuals do not engage in ultimatum bargaining (UG; Güth, Schmittberger, & Schwarze, 1982) for themselves but as proxy deciders for a client.

#### Methods

Participants play a hypothetical ultimatum game either for themselves as responder or for a client as responder. This client is either an unknown person or an unknown person with special needs. Client identity is manipulated in a within-subjects design. The amount of the offer to be split is manipulated, ranging from 0 to 100 € in 10 € steps. The sequence of offers is completely randomized.

#### Results

Identity of the responder modulates the acceptance behavior for high offers (60 to 100 €). Participants accepted less high offers when they decided for an unknown person compared to an unknown person with special needs or for themselves.

#### Discussion

We suggest that the concept of advantageous inequity (Adams, 1965) plays a decisive role when individuals engage in ultimatum bargaining as proxy deciders. The fact that individuals refuse to accept high offers for unknown persons demonstrates that they are averse to being responsible for determining how advantageous inequity is implemented (Gordon-Hecker, Rosensaft- Eshel, Pittarello, Shalvi, & Bereby-Meyer, 2017). However, this aversion decreases when individuals have a reason to justify advantageous inequity, presumably by arguing that an unknown person with special needs is more deserving of support than any unknown proposer.

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.. (2717) ..

**Gender as a cue in decision making?** NADINE NETT<sup>1</sup>, JULIA VALERIE ENGLERT<sup>1,2</sup>, TILLMANN NETT<sup>1</sup>, ROBERT GASCHLER<sup>1</sup> & ANDREAS GLÖCKNER<sup>1</sup>; <sup>1</sup>FernUniversität in Hagen, Germany; <sup>2</sup>Saarland University, Germany

Statistics about gender differences in the workforce show great disparities between the genders. For example, while about half the doctorates in the US are now awarded to women, still only 21% of full professors are female (Shen, 2013). Although this difference may partially be due to differences in lifestyle choices (e.g. Ceci & William, 2011), other studies indicate a direct bias against women in science when such factors can be ruled out (e.g. Moss-Racusin, Dovidio, Brescoll, Graham, & Handelsman, 2012). Previous studies indicate that even processing of objective cues can be influenced by a gender bias (Dorrough, Glöckner, Betsch, & Wille, in press). For instance, Dorrough et al. (in press) presented participants with a matrix in which experts (cues) could recommend one of two products from the same category which was stereotypically associated with a gender (e.g. hand creme, soccer balls). The experts were identified by male or female names. Their gender could either match the gender associated with the product category or not. The results showed that cues are weighted differently in the case of a match or mismatch. These differences can be formally modeled by introducing additional amplification or attenuation of the presented validities (T. Nett, N. Nett, Dorrough, & Glöckner 2016). In the present experiments, the cues were gender neutral (i.e., the gender of the experts was not revealed), yet the options were female vs. male candidates for a job associated with a gender category (e.g. computer scientist or elementary school teacher). Using statistical modeling, we identified the validity of these cues on an individual basis and checked whether gender effects influenced the processing of validities.

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.. (2718) ..

**How explanations based on cognitive distortions are linked to facets of personality ?** ROMAIN BET, CAMILLE BOURRACHOT, CORALIE DUMAS, LÉA GUYON-SERRAN, ANAÏS HOPPE & GEORGE MICHAEL; *Laboratoire d'Étude des Mécanismes Cognitifs, France*

Personality is a sample of individual characteristics, a way of thinking, beliefs, feeling and behavior. Personality traits are present in everyone and change through lifetime by increasing or decreasing a trait. Theories, like the Big 5, suggest that personality can be explained in terms of extraversion, neuroticism, openness, agreeableness and conscientiousness. More recently, psychopathy, narcissism, machiavellianism and sadism were added, as reflecting darker facets of personality. These facets influence our view of the world, our way of thinking about the world and our perception of what is acceptable to do in the society. When offenders are thinking or acting, then they use explanations, mostly based on cognitive distortions, in order to protect themselves in the eyes of society and justice. They, for example, tend to minimize their offenses or to blame others. The aim of this study is to understand the potential links between facets of personality and cognitive distortions. Students from the University of Lyon, France, completed questionnaires assessing facets of personality and cognitive distortions. The results showed that agreeableness correlates negatively with all cognitive distortions, and that neuroticism correlates with only one distortion, "assuming the worst". Moreover, a multiple linear regression indicates that "blaming others" is explained by low agreeableness and psychopathy. This may explain why people with high degree of psychopathy are indifferent to the moral aspect of their offenses.

This study is a preliminary one and will continue with a group of participants who have committed infractions and crimes. This will allow understanding how the ways of thinking influence behaviors in everyday life and determine the way offenders view their own offenses.

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.. (2719) ..

**The role of attention in attribute framing: Using priming to shift attention to the other half of the glass.** HAMUTAL KREINER & EYAL GAMLIEL; *Ruppin Academic Center, Israel*

The attribute-framing bias refers to message recipients' tendency to evaluate objects framed positively (e.g., 75% success) more favorably than objects framed negatively (e.g., 25% failure), although these complementary descriptions are logically equivalent. According to the association-valence account, positive or negative framing activate corresponding positive or negative associations

that bias evaluations. More generally, the attention account contends that focusing attention on one frame while neglecting the complementary frame leads to evaluation biases. To examine the contribution of these theoretical mechanisms to attribute-framing bias, the present study used priming to shift attention to the complementary frame. In two experiments, participants rated objects presented in framing scenarios. Experiment 1 used direct priming, obtained by presenting questions directly related to the target scenario following the scenario (before the evaluation). Experiment 2 used indirect priming obtained by presenting questions not directly related to the target scenarios, prior to the scenario. The framing bias was moderated by priming manipulations that shifted attention to the complementary frame. Whereas direct priming eliminated the bias, indirect priming only moderately diminished it. Jointly, these results suggest that attention and association valence have an additive contribution to the attribute-framing bias. While previous studies discussed the role of attention in attribute-framing bias, mainly as a post-hoc theoretical account, the innovation of the current study is that it demonstrates empirically the contribution of attention. Moreover, in highlighting the joint contribution of association valence and attention mechanisms, this study advances the theoretical understanding of the different cognitive processes underlying attribute-framing bias.

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.. (2720) ..

**The role of attention in inhibitory processes.** AURÉLIE GRANDJEAN<sup>1</sup>, ISABEL SUAREZ DEL CHIARO<sup>2</sup> & LAURENCE CASINI<sup>1</sup>; <sup>1</sup>Aix-marseille Université - CNRS, France; <sup>2</sup>Universidad del Norte, Colombia

Background: Analyzing reaction times (RT) distributions in the Simon task reveals that congruency effects decrease for the longest RTs, however the nature of the processes leading to such a decrease remains a matter of debate. In the present study, we investigated whether mechanisms responsible for this decrease are under a top-down control or whether this decrease of Simon effect with response time reflects bottom-up processes. If top-down mechanisms are involved, the decrease of congruency effect with time should be sensitive to attentional manipulation. Therefore, we carried out different experiments in which the availability of attentional resources was manipulated.

Methods: The participants were required to perform a Simon task concurrently to different secondary tasks. The secondary tasks varied in terms of stimulus modality (auditory or visual) and/or of response type (verbal or segmental). RT distribution analyses (in particular delta functions) were

performed under both single-task and dual-task conditions.

Results and discussion: Results have shown that the reduction of the interference effect with time could be affected when the Simon task was performed concurrently with a secondary task suggesting that the mechanisms responsible for the reduction of the interference effect with time are under some attentional control. Nonetheless, the type of the secondary task seems to be a critical factor.

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.. (2721) ..

**The role of the first impression in a social perception (on the example of the political person evaluation)** NATALIA ANDRIYANOVA & KARINA BAKULEVA; St-Peterburg State University, Russian Federation

The effect of the first impression was founded by S. Asch (1955). One of the reasons of this effect can be the desire to reduce contradictions (Festinger, 1957). R. Rydell and B. Gawronski (2009) showed that when new information contradicts the first impression about any person participants associate it with the context.

In the first experiment we investigate the influence of attractiveness evaluation on the further evaluation of social and political qualities. On the first part the experimental group should evaluate an attractiveness of 60 male photos on the scale from -2 to +2. Next day the participants were informed that men on the photos are the candidates for the elections of deputies of municipal unit. The same photos were accompanied with the list of five demographic and socio-economic characteristics. Participants should evaluate these men on the same scale. Control group participated only in the second part of the experiment.

The results showed that participants from the experimental group evaluated "unattractive" men with positive characteristics higher than participants from the control group. We suppose that person evaluation based on attractiveness is a disapproval act in the society. Therefore participants reduce the contraction and try not to hide differences but emphasize them.

In the second experiment participants from the experimental group should evaluate political initiatives on the scale from -2 to +2. Next day all initiatives were accompanied with five demographic and socio-economic characteristics. Participants should evaluate these candidates on the same scale. Control group participated only in the second part of the experiment. The results showed that participants from both groups evaluated candidates with positive initiatives and negative characteristics higher than candidates with negative initiatives and positive characteristics. Thus, even par-

ticipants from the control group considered initiatives more important for the political evaluation.

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## Poster Session II

S18, Monday, 10:40 – 12:00

.. (2801) ..

**Short-and long-term memory determinants of word-form learning.** LAURA ORDONEZ MAGRO<sup>1</sup>, LUCIE ATTOUT<sup>2</sup>, STEVE MAJERUS<sup>2</sup> & ARNAUD SZMALEC<sup>1</sup>; <sup>1</sup>Université catholique de Louvain, Belgium; <sup>2</sup>Université de Liège, Belgium

**Background:** It is widely assumed that there exists a strong positive link between memory capacity and vocabulary development. Nevertheless, the exact involvement of short-term memory (STM) and long-term memory (LTM) underlying this association is still poorly understood. According to some research, STM for serial-order information plays a crucial role in temporarily maintaining and refreshing the order of phonemes that represent a novel word. Other researchers suggest that LTM is involved in the consolidation of these phoneme sequences, through long-term serial-order learning.

**Methods:** We tested 131 6- to 7-year-old children on a series of memory tasks. One set of tasks targeted STM for serial-order information versus item information. The other task focused on long-term serial-order learning, using the Hebb repetition paradigm. Vocabulary development was operationalized through a novel word-form learning (NWFL) task. We hypothesized that STM for serial-order (compared to item) information would correlate with performance in the initial stages of NWFL, whereas the magnitude of Hebb learning would be more strongly associated with the final stages of word-form learning.

**Results:** As expected, Bayesian correlation analyses revealed a clear link between STM for serial order and the initial but also the final stages of NWFL. This was not the case for STM for item information. The results also indicated an association between LTM for serial order and the final but not the initial stages of NWFL.

**Discussion:** The current study shows that STM for serial order is to some extent equally involved from the beginning to the end of the NWFL process. Further findings demonstrate that Hebb-learning principles predict consolidation of new phonological material. In sum, this study shows the existence of a complex interaction between STM and

LTM mechanisms allowing children to capture linguistic input from their environment and to consolidate it in long-term, stable linguistic representations.

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**Identity Priming in Picture Naming: Decay and Effects of Ageing.** ELLA CREET<sup>1,2,3</sup>, JULIE MORRIS<sup>1</sup>, DAVID HOWARD<sup>1</sup> & LINDSEY NICKELS<sup>3</sup>; <sup>1</sup>Speech and Language Sciences, School of Education, Communication and Language Sciences, Newcastle University, Newcastle, United Kingdom; <sup>2</sup>International Doctorate for Experimental Approaches to Language and Brain (IDEALAB), Potsdam University, Germany, Groningen University, Netherlands, Trento University, Italy, Newcastle University, UK, and Macquarie University, Australia; <sup>3</sup>ARC Centre of Excellence in Cognition and its Disorders, Department of Cognitive Science, Macquarie University, Sydney, Australia

**Background**

In picture naming, identity priming refers to improved naming of an item due to previously having named it (Francis, 2014). The single repeat presentation of a picture has been shown to significantly reduce individuals' response times even at long delays of weeks or even months (Mitchell & Brown, 1988; Cave, 1997). However, the vast majority of previous research uses identical pictures at both time points and therefore it is difficult to distinguish priming of word retrieval processes from priming of picture identification. In this study we aimed to better separate out these processes by using different depictions of the items and also to explore the effect of ageing on priming.

**Method**

24 young adults and 24 older adults participated. Across four sessions, four sets of 165 pictures (and fillers) were presented for naming. Each set was repeated for naming using different depictions with varied delays between repetitions: Minutes, 1-day, 1-week, 6-months. At 6 months half of the depictions were identical, half changed.

**Results**

Significant main effects of priming and time delay were found with a significant interaction between the two, with the magnitude of priming decreasing across time for both young adults (minutes: 70ms, 1-day: 57ms, 1-week: 30ms) and older participants (minutes: 73ms, 1-day: 45ms, 1-week: 25ms). A main effect of age was found but no significant interactions with priming or delay. 6-month testing is ongoing and results will be provided.

**Discussion**

We replicated the finding of robust repetition priming at a delay of 1 week. However, the effect was much smaller than previously reported which

suggests that a large component of previous effects was due to using the same depiction. The results of the 6-month testing will allow us to test the hypothesis that priming of picture recognition played an important role in previous reports.

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.. (2803) ..

**Does bigram frequency genuinely impact visual word recognition? An ERP study.** KARINNE SAUVAL & FABIENNE CHETAIL; *LCLD, CRCN, Université Libre de Bruxelles*

Repeatedly exposing readers to print makes them sensitive to the fact that some letters or letter groups occur more frequently than other ones. Among the different types of orthographic regularities, the role of bigram frequency has been the most hotly debated in the field. At an empirical level, some studies reported detrimental effects of bigram frequency in the lexical decision task, with words including high-frequency bigrams being processed less efficiently than words with low-frequency bigrams. The more developed proposal to explain this detrimental effect is that low-frequency bigrams would help to reduce the set of lexical candidates, since they are the most diagnostic to identify a word. At the sublexical level, however, bigram and letter frequency would facilitate processing. Hence, depending on the task, the early facilitative and the later detrimental effects could cancel each other, leading to null effects. Another proposal is that bigram frequency has no influence in visual word recognition per se and the few effects reported in the past would be due to confounds with word frequency or orthographic neighborhood. Given this mixed pattern of results and the alternative explanations, the aim of the present study was to test the impact of bigram frequency using EEG, since this method enables one to observe joint facilitative and detrimental effects during the timing of word recognition. Two categories of words contrasted on summed bigram frequency were selected, while carefully controlling for potential confounded variables. We recorded neural activity through 64 channels while participants performed a semantic detection task. Overall, waveforms showed some evidence of a facilitative effect around 150 ms and of a detrimental effect from 250 after the word onset. These results support the hypothesis that bigram frequency has an influence during word processing. Results will be discussed in the interactive activation framework of visual word recognition.

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**Neural correlates underlying sign language processing in hearing bilinguals.** BRENDAN COSTELLO<sup>1</sup>, PEDRO PAZ-ALONSO<sup>1</sup> & MANUEL CARREIRAS<sup>1,2,3</sup>; <sup>1</sup>BCBL (*Basque Center on Cognition, Brain and Language*), Spain; <sup>2</sup>Ikerbasque, *Basque Foundation for Science*, Spain; <sup>3</sup>Department of Basque Language and Communication, *University of the Basque Country UPV/EHU*, Spain

Sign language (SL) provides the opportunity to examine modality effects in language processing. Previous neuroimaging evidence has shown that overall SL recruits a similar set of left-lateralized perisylvian regions to those engaged in spoken languages, including the inferior frontal gyrus (IFG) and the posterior superior temporal gyrus. However, there are still many unanswered questions regarding the functional dynamics supporting SL processing. For instance, does regional engagement of left-lateralized perisylvian regions during language processing differ as a function of modality? Is there a specific functional signature of SL processing? To what extent does language processing rely on different neural dynamics as a function of being a native versus a L2 signer?

The present fMRI study sought to investigate these questions in three different groups of hearing bilinguals: 23 native Spanish Sign Language (LSE)-Spanish bilinguals, 20 late LSE-Spanish bilinguals and 23 bilingual controls without LSE knowledge. During scanning participants processed LSE signs, presented as (silent) videos, and Spanish words, presented either aurally (sound only) or audiovisually (a video of a model saying the word with sound). Each of these three types of stimuli was contrasted to corresponding baselines, consisting of scrambled video and/or rotated speech.

Results confirmed that SL and spoken language recruited a similar set of left-perisylvian regions. Nevertheless, signers exhibited significant stronger regional engagement for SL processing than for spoken language processing across left-perisylvian nodes. Moreover, signers showed stronger activation in left IFG to process signs compared to sign-naïve controls. Furthermore, L2 signers showed involvement of the right parietal lobe relative to native signers. These results constitute the strongest evidence so far showing differential modality-specific neural dynamics involving SL processing in hearing bilinguals.

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.. (2805) ..

**Thinking In Two Languages: Evidence For L2 Co-Activation During L1 Production.** JANA KLAUS, KRISTIN LEMHÖFER & HERBERT SCHRIEFERS; *Radboud University Nijmegen, The Netherlands*

Previous research has shown that when speakers produce words in their second language (L2), they also activate the phonological form of the translation of the word in their first language (L1). This has been interpreted as an inability to entirely suppress one's L1 during L2 production. In three experiments, we investigated whether this also holds in the opposite direction, i.e., when participants speak in their L1 (Dutch) without any inherent need to co-activate their L2 (English). To this end, we made use of the so-called phonotranslation effect. In a picture-word interference task, speakers named pictures in their L1 (e.g., "lepel" [spoon]) while ignoring auditory distractor words that were phonologically related to the L2 translation of the target word (e.g., "spook") or unrelated (e.g., "dot"). Naming latencies were significantly longer in the related compared to the unrelated condition, providing evidence that the L2 translations were activated up to the phonological level and interfered with the production of the L1 target words, although L2 was not the target language. Crucially, this pattern did not differ as a function of the language context: The effect was obtained both when speakers were addressed in Dutch throughout the experiment, as well as in English. Moreover, we found no evidence that the size of this effect depends on individual L2 proficiency. We conclude that co-activation of two languages works both ways and is not restricted to the dominant language.

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**The role of stimulus variability in non-native sound production learning: evidence from behavioral and neuronal measures.** NATALIA KARTUSHINA<sup>1</sup>, MARTIJN BAART<sup>2</sup> & CLARA D. MARTIN<sup>1</sup>; <sup>1</sup>*Basque Center on Cognition, Brain and Language, Spain*; <sup>2</sup>*Tilburg University, the Netherlands*

Accent-free production in non-native language (L2) is a challenging task for late L2 learners. These difficulties in L2 production can be remediated by training, whereby learners receive feedback on their performance.

Studies in L2 perception have shown that high-variability training (HVT) leads to greater improvements and generalization to new talkers as compared to low-variability training (LVT). Importantly, the former leads to an establishment of neural traces for L2 sounds, revealed by an augmentation in mismatch negativity (MMN) amplitude after training. Research in motor learning in humans

and, in vocal learning in birds suggests that variability is necessary for the development of expertise, but no study so far has addressed the role of variability in L2 speech sound production. Our work explores, for the first time, behavioral and neural plasticity resulting from learning to produce non-native speech sounds.

Thirty native Spanish speakers were trained with articulatory feedback to produce unfamiliar French vowel contrast /e/-/ε/ that assimilates to Spanish /e/. During training, on each trial, participants heard the target vowel, repeated it and received immediate visual feedback showing the location (in F1/F2 space) of their production along with that of the target. Participants were trained over 3 days with either tokens from a set of vowels recorded by a single speaker (LSV group, n=15) or by five speakers (HSV group, n=15). The improvements in production were assessed in vowel repetition task. Event-related potentials to target vowels in listening oddball paradigm were recorded before and after training to assess the neural plasticity.

The results showed that LVT improved the production accuracy only, whereas HVT led also to the generalization of learning to novel talkers. The electrophysiological results are currently under analysis. It is hypothesized that HVT leads to an increase in MMN amplitude, revealing the establishment of new categories.

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.. (2807) ..

**What was that Spanish word again? The role of between-language competition in foreign language attrition.** ANNE MICKAN, KRISTIN LEMHÖFER & MCQUEEN JAMES; *Radboud University, Nijmegen, The Netherlands*

While foreign language (L2) acquisition is a booming area of research, knowledge regarding the process of L2 attrition (forgetting) is scarce. Previous research has mainly documented the occurrence of attrition, but has done little to unravel its underlying cognitive mechanisms. This study takes a memory perspective on the issue and assesses domain-general theories of forgetting in their application to L2 lexical attrition.

Competition-based theories of forgetting posit that retrieval inability for a given memory is primarily driven by interference and competition from other memories. Regarding L2 attrition, the question arises whether it is the interference from translation equivalents in other more recently used languages, like the native language (L1) or other foreign languages (L2+), that causes subsequent retrieval failure for L2 words.

We manipulated the presence of L1/L2+ interference and assessed its consequence for L2 vocabulary retention. In Experiment 1, Dutch native

speakers with some knowledge of Spanish (L2) learned to name pictures with their (previously unknown) Spanish names. A day later, after consolidation, they performed a number of naming tasks in either Dutch or English on half of these pictures. Finally, memory for all items was tested again in Spanish. Preliminary results show that, as hypothesised, recall was slower and less complete for words that received interference than for words that did not, and that this effect was larger for English (L2+) compared to Dutch (L1) interference. In Experiment 2 which is still on-going, the reversed question is investigated, namely, whether a newly learned language (again, Spanish) can induce forgetting of an already established L2+ (English). So far, the preliminary results from Exp. 1 ( $N = 25$ ) seem to suggest that competition from other, more recently used languages (and especially from other non-native languages) is indeed one force causing forgetting of L2 words.

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.. (2808) ..

**Classification of Stuttering Type by Speech-Language Modality.** FUMIKO ANZAKI<sup>1,2</sup>, SAYOKO YAMAMOTO<sup>2</sup> & MITSUYO SHIBASAKI<sup>3</sup>; <sup>1</sup>*Allied Health Sciences, Yamato University, Osaka, Japan*; <sup>2</sup>*Non-profit Organization TBI Rehabilitation Center, Tokyo, Japan*; <sup>3</sup>*Department of Psychology, Meisei University, Tokyo, Japan*

**Background:** Adults with persistent stuttering frequently demonstrated left white matter deficiencies (Chang, 2008). Hudock (2011) demonstrated that visual speech feedback reduced stuttering frequency. We examined stuttering frequency for each task using different speech-language modality, and tried the classification of stuttering types.

**Method:** Thirty-nine (35 males, 4 females) people who stutter (PWS) participated in this study. All the participants were right-handed, and the mean age was  $31.5 \pm 13.4$  years. Participants were asked to perform a Japanese stuttering test that comprised a free talk (FT), explanation of situation picture (ES), and read aloud sentences (RA) tasks. All utterances were recorded and stuttering frequency was calculated for each task. Cluster classification (ward method) was then performed using speech-language modality as a variable.

**Results:** Eleven (28.2%) PWS displayed functional articulation disorders. Fourteen (35.9%) PWS showed difficulty in controlling speech speed. In RA task, 20 (51.3%) PWS had stuttering frequencies of 1% or less. Comparing stuttering frequency between RA and ES tasks, we observed that the participants performed RA more easily than they performed ES [ $t(38) = -2.31$ ,  $p < 0.05$ ]. We compared three groups in cluster classification. The mild group displayed few stuttering frequency in

every task. The moderate group showed more stuttering frequencies in FT and ES tasks. The severe group showed high stuttering frequency in every task. Participants with functional articulation disorders were distributed throughout the groups.

**Discussion:** In conclusion, we report that RA task was the easiest to perform. The visual feedback provided by sentences reduced stuttering frequency more effectively than that provided by pictures. The severe group displayed difficulties in every task, including RA task. We consider that PWS have not only motor articulately problem but also neuron fiber access problem from sentence completion area to articulately program area.

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.. (2809) ..

**The representation of letters with diacritics: A priming study in french.** EMELINE BOURSAIN & FABIENNE CHETAIL; *ULB, Université Libre de Bruxelles, Belgium*

According to current theories of letter recognition, the identification of letters operates through abstract representations. However, most theoretical models heavily rely on studies carried out in English and thus limit the description of the mechanisms of letter recognition to the 26 letters of the Latin alphabet. Yet, a large number of scripts include letters with diacritic marks, as in French for example (à, â, é, è, ç...). It is therefore necessary to examine how letters with diacritics are processed. Some studies support the idea that letters with diacritics activate the same abstract representation than letters without diacritics (i.e., a = à). Given that there is no established consensus on how letters with diacritics are perceived in French, we investigated if they activate the same abstract identity as the analogue letter (i.e., a = à) or if they activate two different representations (e.g., a ≠ à as a ≠ z). In Experiment 1, the participants ( $n = 57$ ) performed an alphabetical decision task. They had to indicate if the target letter presented was a letter of the French alphabet or not. Three primes were devised for each target: repeated prime (e.g., a-A), diacritic prime (e.g., à-A), and control prime (e.g., z-A). In Experiment 2, the participants ( $n = 48$ ) performed a lexical decision task. They had to indicate if the target word –primed with the same three conditions (i.e., repeated: melon - MELON, diacritic: mélon - MELON or control: mulon - MELON) was a French word or not. In both tasks, the data showed shorter reaction times in the repeated prime condition compared to the diacritic and control prime conditions, but there was no significant difference between the diacritic and control prime conditions. These data are in favor of different abstract representations of the letter with diacritics and the analogue letter.

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**Effect of lexical stress on early stages of visual word recognition: evidence with a letter search paradigm.** SVETLANA ALEXEEVA & ALEKSANDRA DOBREGO; *St. Petersburg State University, Russian Federation*

It is widely thought that in alphabetic writing systems printed words are recognized via their constituent letters. There is also growing evidence suggesting that phonological information plays an early role in visual word recognition. In the study, we investigate whether lexical stress influences identification and encoding of letter position within letter strings in Russian. To reveal mechanisms that underlie recognition on early stages of word processing, we adopted a letter search task. In the task, participants are required to detect the presence/absence of a previously cued letter target within a five-letter string. Reaction time is measured. Using this paradigm, the M-shaped search function (exterior letter position advantage) was previously found, and this pattern could be explained with parallel letter identification constrained by crowding (visual complexity) and visual acuity (Tydgate & Grainger, 2009). In our experiment, stimuli were either real words of Russian or legally pronounced pseudowords. All ten vowels of Russian were shown to subjects, half in the stressed position, and half in the unstressed one. 500 subjects participated in the preliminary study that aimed at defining the stressed syllable in pseudowords. We performed the linear mixed effects analysis to assess the effect of letter position, lexical stress, visual complexity (Pelli et al., 2004), and type of string on detection latencies. Results show that (a) stressed vowels are identified faster than unstressed ones; (b) visual complexity interacts with letter position: the least complex vowels produce the classic M-shaped visual search function whereas for the most complex vowels the search pattern is inverted (final position disadvantage); (c) there is no evidence that lexical status of the string affects task performance. Our results confirm the hypothesis of (Tydgate & Grainger, 2009) that favors parallel letter identification. Moreover, we found early phonological influences of the lexical stress on visual word recognition. Funded by RSF#14-18-02135.

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**Syntactic Processing of Garden Path Sentences: Differences Depending on Subordinate Clause Type.** NOELIA AYELEN STETIE<sup>1</sup> & GABRIELA MARIEL ZUNINO<sup>1,2</sup>; <sup>1</sup>*Universidad de Buenos Aires, Argentine Republic*; <sup>2</sup>*CONICET, Argentine Republic*

Many research has been developed about garden path sentence processing (Waters & Caplan, 2001; Sturt, Scheepers & Pickering, 2002; Vos et al., 2001;

Gordon, Hendrick & Levine, 2002; Fiebach et al., 2005). In Spanish and other languages, studies have usually worked with garden path sentences with time adverbial clauses (Meseguer, Carreiras & Clifton, 2002; Véliz et al., 2011; van Gompel et al., 2005; Pickering, Traxler & Crocker, 2000; Traxler & Frazier, 2008; among others).

In this study, we present the preliminary results of a pilot experiment with Spanish speakers. Our main objective was to study whether place adverbial clauses generate the same garden path effect as time adverbial clauses.

We designed a reaction time paradigm task that involved reading sentences in two conditions (ambiguous vs. unambiguous) with two types of adverbial clauses (place vs. time) segmented into five phrases and verifying correspondence with a sentence presented as a whole, immediately afterwards.

Reading times, sentence recognition times and response accuracy were recorded and analyzed. The preliminary results indicate that there is a distinction between adverbial clauses of time and place: the classical effect found for temporal garden path sentences was not clearly replicated for locative sentences in our pilot experiment. The reading times of both structures were similar when they were in their unambiguous version, but they were different when the sentence presented ambiguity. The "garden path verb" had greater reading times in ambiguous sentences with adverbial clauses of time, implying that a reanalysis of the structure took place and required a bigger processing cost. However, we did not find this time difference in the sentences with adverbial clauses of place. This results could be pointing out the influence of non syntactic information, such as frequency distinctions between clauses.

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**When speakers keep their focus – alternative inhibition in language production.** KATHARINA SPALEK & BEATE BERGMANN; *Humboldt-Universität zu Berlin, Germany*

Linguistic focus highlights the importance of alternatives for the interpretation of an utterance. "The TIGER is red.", with a focus accent on tiger, not only expresses something about the tiger, it also implies that something else (the alternative(s)) is not red. Listeners activate alternatives when they process a focused element. We do not know what speakers do when they decide to focus a particular constituent.

Twenty-two German participants named coloured line drawings with a phrase like "Der Elefant ist rot." ("The elephant is red."). The subsequent trial either presented a different animal or a dif-

ferent colour. If speakers are sensitive to the sequence's information structure, they should focus the novel dimension. Thus, for a red elephant followed by a red tiger, the response is "The TIGER is red.", whereas for a green tiger followed by a red tiger, it is "The tiger is RED." On half of the trials, a letter string appeared while participants were preparing their response. Participants had to make a lexical decision on this probe. On critical trials, the probe was related to the pictured object, for example AFFE (monkey). Depending on the focus structure of the target utterance, the probe was either a focus alternative (as in "The TIGER is red.") or not (as in "The tiger is RED." - where an alternative would be another property rather than another animal).

Reaction times on the probe word were analysed with FOCUS STATUS as independent variable. Participants' responses were 21 ms slower for focus alternatives ( $t = 2.24$ ).

The findings show that choosing a particular focus structure influences activation spreading during language production: Speakers inhibit possible alternatives when focussing an element in focus. This is the opposite of findings from language comprehension where focus alternatives are recognized faster, in line with comparable production/ comprehension asymmetries in language processing. Email: [katharina.spalek@hu-berlin.de](mailto:katharina.spalek@hu-berlin.de)

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**Predictors of English reading for Mandarin-English bilingual students in Higher Education.** CHUNYANG LIANG<sup>1</sup>, GEORGIA NIOLAKI<sup>1,2</sup>, JANET VOUSDEN<sup>1</sup> & LAURA TAYLOR<sup>1</sup>; <sup>1</sup>Coventry University, United Kingdom; <sup>2</sup>Institute of Education, UCL

According to the dual-route model, which was proposed by Coltheart et al. (2001), reading in different languages rely on different processes. Moreover, a growing literature has demonstrated that English reading relies more on phonological ability processes, and visual analytic skills are more important in Chinese reading. However, most of the research has focused on preschool children. Additionally, little of this research has examined whether the reading processes of English- and Mandarin-speaking bilingual students are different in comparison to their monolingual peers. 15 English monolingual adults (mean age: 29.63 years, SD=11.40) and 15 Mandarin-English bilingual adults (mean age: 22.80 years, SD=1.61). The students were tested in reading (both accuracy and reaction times were recorded), in a spoonerism test and visual memory tasks (times needed to complete the tests were recorded). We found a significant association between English reading speed and the reaction times for visual memory for sequen-

tial presentation in both groups, but not to other tasks. These results are consistent with previous research that adults with non-alphabetic (Mandarin-English) and alphabetic (English) first language will rely on similar processes when reading real words, and these are whole-word visual/orthographic processes (Holm & Dodd, 1996). However, previous research found that phonological awareness is the strongest predictor of English reading (for a review see Frost, 1998), which is inconsistent with the results of the current study. The plausible explanation is, for English monolingual adults, skilled readers rely more on the lexical in comparison to the sublexical pathway (Ziegler & Goswami, 2005). Therefore, their performance on visual skills are highly correlated to their English reading ability. As for Mandarin-English bilingual adults, they use their rote memory when they learn to read in Chinese. Thus, they are expected to use similar strategies when they learn the second language (McBride-Chang et al., 2014).

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**The syllable frequency effect in oral and hand-writing production of French words for young and older adults.** CHRISTELLE ROBERT & STÉPHANIE MATHEY; *University of Bordeaux, France*

The present research investigated how and to what extent syllable frequency influences the oral and written production of words in young and older adults. In young adults, syllable frequency effects have been found in speech production (e.g., Cholin et al., 2006) and visual word recognition (e.g., Mathey & Zagar, 2002). Studies on handwriting have also provided evidence that the syllable is a relevant unit during the production of written words in young adults (e.g., Kandel et al., 2006). In the field of cognitive aging, syllabic effects in visual word recognition differed between young and older adults, which suggested age-related changes in word processing (Carreiras, Baquero & Rodriguez, 2008). In this study, we expected that the syllable frequency effect should be observed in both spoken and written word production in young adults, and that this effect should be reduced in older adults. The 38 young (mean = 21 years old) and 39 older adults (mean = 69 years old) performed an oral and a written syllabic fluency task. For each task, all participants were given 90 sec to produce as many words as possible that begin with a given phonological syllable (either of high- or of low-frequency). The results indicated that more words were produced when the syllable was of high- rather than of low-frequency. This syllable frequency effect was obtained for both syllabic fluency tasks, confirming that the phonological syllable plays a role in both spoken and writ-

ten word production. Overall, the older adults produced fewer words than the younger ones in both oral and written tasks (see also Robert & Mathey, 2017). More importantly, the syllable frequency effect was dramatically reduced for the older adults. The theoretical implications of these results are discussed in terms of lexical activation processes in the field of word production and aging.

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**Are universal phonological features reliable for segmenting syllabically when no statistical cues are available? Evidence in French skilled readers.**

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Previous studies conducted in French demonstrated that syllables are used as prelexical and segmental units in silent reading in skilled readers. However, most of these studies focused on the importance of statistical and distributional properties to account for the syllable effects. Besides, these studies were done with many foreign natives but rare studies focused on French language and on reading. Our aim was to explore how skilled readers segment printed (non)words when no reliable statistical cues were available around – and within – the syllable boundary. We were interested in how the sonority – a universal feature-like phonological element – might be a reliable source for syllable segmentation. We tested 160 native French-speaking adults. We used disyllabic non-words with bigrams, trigrams and syllables with (quasi)null frequencies in initial positions in a revisited version of a lexical decision task, in the sense that we focused on the reaction times of the participants to reject stimuli not belonging to French lexicon. We manipulated five sonority profiles (high-fall, low-fall, plateau, low-rise, high-rise) within the syllable boundaries along a continuum from legal to illegal clusters. An asterisk mark was inserted either in 2nd, 3rd or 4th position of the non-word, generating a(n) (ill)-legal structure. Our results show that French adults are sensitive to the optimality of the sonority profiles and of the syllable structure to locate the syllable boundary. As illegality of the structure and of the sonority profile increased, French adults had higher reaction times to identify a syllable boundary as illegal. These results show that the (quasi)absence of statistical and distributional properties around and within the syllable boundary did not prevent from segmenting syllabically. This also suggests that segmentation strategies of printed stimuli do not only depend on a strict statistical and distributional analysis but also on a universal phonological sensitivity based on sonority.

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.. (2816) ..

**The syntax of idioms: a “special” status?**

AZZURRA MANCUSO<sup>1</sup>, ANNIBALE ELIA<sup>2</sup>, ALESSANDRO LAUDANNA<sup>1</sup> & SIMONETTA VIETRI<sup>2</sup>; <sup>1</sup>LaPSUS, Laboratory of Experimental Psychology, University of Salerno, Italy; <sup>2</sup>Linguistics and Computational Linguistics Laboratory “Maurice Gross”, University of Salerno, Italy

A key question about idiom processing pertains the syntactic behaviour of these expressions. There is large variability in terms of syntactic productivity, that is, how idioms differ in the extent to which they can be syntactically altered. Thus, some idioms, (e.g., The law was laid down by John) are syntactically productive, while others, (e.g., The bucket was kicked by John) are not perceived as idiomatic when they are syntactically transformed. These characteristics pose challenging problems for theories about the format of idioms in the mental lexicon (Swinney and Cutler, 1979; Cacciari and Tabossi, 1988; Gibbs and Nayak, 1989; Cutting and Bock, 1997; Sprenger et al., 2006). This study provided empirical evidence about processing of transformed versus untransformed idioms. The rationale was the following: if idioms are stored as lexical units, then a syntactic transform should increase processing demands, whereas if idioms are processed as other word strings, there should be no differences in the amount of processing needed for transformed versus untransformed idioms. Also, we aimed at investigating the distinction between ambiguous (sentences with a literal plausibility) and unambiguous idioms.

In two experiments, Italian idioms (*alzare il gomito*, “to drink too much”) were auditorily presented in canonical and transformed forms (passive or left dislocation), followed by words semantically related (*UBRIACO*, “drunk”) or not (*VELOCE*, “fast”). In Exp. 1, participants judged whether targets were semantically related to idioms; in Exp. 2, participants had to make a lexical decision on targets. The results did not show differences between canonical and transformed conditions: idioms maintain their idiomatic meaning, regardless of their syntax. Intriguingly, ambiguous idioms are slower to be processed than unambiguous when their literal interpretation is incompatible with responses. The results support the hypothesis that idiom syntax is not idiosyncratic, but principled by same rules of literal language (Tabossi et al., 2009).

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.. (2817) ..

**The Role of Grammatical Properties in the Word-Picture Interference Paradigm: Data from Single Verbs Production in Italian.** MARIA DE MARTINO & ALESSANDRO LAUDANNA; *UNIVERSITY OF SALERNO, Italy*

Several studies reported competition effects in word-picture interference (WPI) experiments and attributed them to grammatical constraints in the lexical selection process depending on the activation of shared grammatical information (i.e., grammatical class (GC), gender and inflectional class (IC)) between targets and distracters.

An alternative account states that a selective attention mechanism operates in WPI tasks, where properties of target words (i.e., being an object or an action) determine if distracter words constitute potential responses to the target picture.

In this study we describe 4 WPI experiments: Italian speakers named pictures of actions by means of inflected verbal forms (3rd singular person of the Present Indicative, Experiments 1a and 2a) or of infinitive forms (Experiments 1b and 2b).

Inflected (Exp. 2a and 2b) and Infinitive verbs (Exp. 1a and 1b) were used as distracters and they shared or not the same target's IC.

A control condition with a noun distracter and a baseline (a row of Xs) were also included.

Filler stimuli guaranteed for the proportion of noun and verb distracters.

Nouns and verbs distracters were matched for length, written form frequency, imageability and semantic category of their referents (actions).

Semantic and/or formal relations between targets and distracters were avoided.

An interference effect due to shared IC between target and distracters was detected; the effect was modulated by the target and/or distracter Finiteness. IC and Finiteness information also affected GC effects: infinitives did not differ from noun-distracters and inflected verb-distracters significantly interfered more than noun-distracters only in the non-congruent IC condition.

This pattern of results is compatible with the intervention of grammatical constraints during production processes, as explored in WPI tasks. In our interpretation, at least for languages where lexical stems do not correspond to words, such a mechanism manages stem+affix combinations during the assembling of morphemic constituents of words.

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.. (2818) ..

**Does bilingual immersion education influence executive control?** MORGANE SIMONIS, BENOIT GALAND, PHILIPPE HILIGSMANN & ARNAUD SZMALEC; *Université catholique de Louvain, Belgium*

Bilingualism is generally considered to positively influence cognitive development, especially at the level of executive control (see Hilchey & Klein, 2011, for a review). However, several recent studies have failed to find coherent evidence for executive control advantages in bilinguals (Paap & Greenberg, 2013). As a result, the cognitive implications of bilingualism are currently a big issue of controversy and it remains unclear under which circumstances the cognitive benefits of speaking two languages do or do not emerge. One particular method to learn a second language, or become bilingual, is through immersion education, a context where parts of the school subjects are instructed in the learners' second language. Some of the cognitive benefits associated with early bilingualism have been demonstrated after three years in an immersion education setting (Nicolay & Poncelet, 2013; 2015). The present study is aimed at examining to what extent the effects of bilingualism on executive control may occur through second-language immersion education in French-speaking Belgium. To this end, we recruited a large sample of 312 immersed children and 335 controls, in grade 5 or 11. The immersed participants were in immersion education since at least 5 or 4 years, respectively. All participants performed a Simon task and an Attentional Networks Task (ANT) assessing inhibitory control and a version of the Dimensional Change Card Sort (DCCS) measuring mental-shifting. Control variables such as non-verbal intelligence, the number of years in immersion education and other potentially relevant background variables were also taken into account. The results show no overall differences in executive control between the immersed group and the control children.

Additional longitudinal data on the ANT and non-verbal intelligence, as well as an n-back updating task, are currently collected and will also be presented. Findings will be discussed in relation to the cognitive implications of bilingualism.

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.. (2819) ..

**The organisation of the bilingual toddler lexicon.** CLAIRE DELLE LUCHE<sup>1</sup>, IRINA LEPADATU<sup>2</sup>, KIM PLUNKETT<sup>2</sup> & CAROLINE FLOCCIA<sup>3</sup>; <sup>1</sup>*University of Essex, United Kingdom*; <sup>2</sup>*University of Oxford*; <sup>3</sup>*Plymouth University*

Semantic properties of words are activated from the age of 21 months in a priming paradigm (Arias-Trejo & Plunkett, 2013): hearing related prime-target pairs facilitates target recognition. This study investigates semantic activation in 24-to-27-month-old bilingual toddlers (with monolingual controls).

Priming is used in Experiment 1, whereby children hear a carrier sentence followed by the tar-

get word (related trial: fish-frog; unrelated: slide-frog) and two pictures (the target and a distracter). Increased looking times to the target for related trials indicate semantic activation. Results from the monolingual group (N=59) showed the expected semantic activation. No priming effect was observed with the bilingual group (N=37). Adding linguistic distance (LD, Chiswick & Miller, 2005) as a covariate revealed an interesting pattern, with an effect of priming and an interaction with LD: children learning distant languages (e.g., English and Chinese) show a larger priming effect (similar to monolinguals), while close language bilinguals (e.g., English and Swedish) do not show a priming effect. It is implausible that close language bilinguals do not have a semantically organised lexicon. However, language proximity might hinder language identification, possibly through lexical competition, and therefore hinder word recognition.

Experiment 2 investigates one hypothesis to account for this surprising LD effect: close languages share a high number of cognates (e.g., baby and bébé in French). Experiment 2 tested whether cognates and non-cognates are processed differently in a word recognition task (38 bilinguals and 29 monolinguals). As expected, cognate status does not affect monolinguals' looking behaviour, but bilinguals show a result commensurate with a cognate advantage (in adults, see Voga & Grainger, 2007): cognates are recognised faster.

Altogether, this study reveals two important linguistic factors affecting lexical access, and potentially semantic activation: linguistic distance and cognate status. Ongoing work is exploring whether phonological representations are the common explanatory factor.

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.. (2820) ..

**BiLex-Kids: A Bilingual Word Database for Children 5-13 Years Old.** ARIS TERZOPOULOS<sup>1,2</sup>, GEORGIA NIOLAKI<sup>2</sup>, LYNNE DUNCAN<sup>1</sup>, MARK WILSON<sup>3</sup>, ANTONIOS KYPARISSIADIS<sup>4</sup> & JACKIE MASTERSON<sup>5</sup>; <sup>1</sup>University of Dundee, United Kingdom; <sup>2</sup>Coventry University, United Kingdom; <sup>3</sup>No affiliation; <sup>4</sup>Nottingham University; <sup>5</sup>University College London

As word databases for bilingual children are not available, researchers, educators and textbook writers must rely on monolingual databases. The aim of this study is thus to develop a bilingual word database, BiLex-kids, an online open access developmental word database for 5-13 year old bilingual children who learn Greek as a second language and have English as their dominant one. BiLex-kids is compiled from 120 Greek textbooks used in Greek-English bilingual education in the UK, USA and Australia, and provides word translations in the

two languages, pronunciations in Greek, and psycholinguistic variables (e.g. Zipf, Frequency per million, Dispersion, Contextual Diversity, Neighbourhood size). The database is currently under construction using the same methodology and online platform as HelexKids ([www.helexkids.org](http://www.helexkids.org)), the first database for Greek monolingual children (Terzopoulos, Duncan, Wilson, Niolaki & Masterston, 2016). After clearing the textbooks of non-relevant items (e.g. punctuation), algorithms were applied to extract the psycholinguistic indices for all words. As well as one total lexicon, the database produces values for all ages (one lexicon for each age) and for three age bands (one lexicon per age band: 5-8, 9-11, 12-13 years).

BiLex-kids provides researchers with accurate figures for a wide range of psycholinguistic variables, making it a useful and reliable research tool for selecting stimuli to examine lexical processing among bilingual children. In addition, it offers children the opportunity to study word spelling, learn translations and listen to pronunciations in their second language. It further benefits educators in selecting age-appropriate words for teaching reading and spelling, while special educational needs teachers will have a resource to control the content of word lists when designing interventions for bilinguals with literacy difficulties.

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## Poster Session III Ground, Tuesday, 10:40 – 12:00

.. (3001) ..

**Motivation in prospective memory: a review of the existing literature.** GEOFFREY BLONDELLE, MATHIEU HAINSELIN, YANNICK GOUNDEN & VÉRONIQUE QUAGLINO; *Centre de Recherche en Psychologie : Cognition, Psychisme, Organisations*, EA 7273, Université de Picardie Jules Verne, Amiens, France

Prospective memory (PM) refers to memory for activities to be performed in the future (Einstein & McDaniel, 1990). This ability is essential in everyday life to manage activities and is of utmost importance in maintaining autonomy. Research on cognitive psychology on this concept has led to significant progress in understanding the processes underlying the functioning of PM. Here we present a state of the art on the relationship between PM and motivation.

Several researchers have studied the impact of motivation through different theoretical models centered on PM (e.g., Kvavilashvili & Ellis, 1996,

McDaniel & Einstein, 2000) and have defined it as referring to the perceived importance of the PM task by participants. Different methods are used to operationalize motivation: (1) providing a reward (2) providing a social motive (3) prioritizing either the PM task or simply prioritizing the ongoing task (i.e., relative importance manipulation), or (3) emphasizing the importance of the PM task (i.e., absolute importance manipulation).

The goal (i.e., mental representation of the aim of a course of action; see Kruglanski, 1996) is a central aspect of the contemporary conceptions of motivation, and in the relationship between motivation and PM (Penningroth & Scott, 2007). Goals are hierarchically and temporally organized, they contribute to the achievement of a broader goal. For example, having a goal to (1) make an appointment with the physician every three months (2) go to the pulmonologist for an annual follow-up appointment and (3) take medication every day are a priori three isolated objectives that contribute together to a long-term quality of life improvement (superordinate goal).

In this conference, we will present the different methodologies used in the literature to manipulate task importance in PM. Finally, we will review studies that support a goal-based motivational-cognitive model of PM.

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.. (3002) ..

**When divided attention fails to enhance memory encoding: The Attentional Boost Effect is eliminated in young-old adults.** GIULIA BECHI GABRIELLI<sup>1,2</sup>, PIETRO SPATARO<sup>1</sup>, LINA PEZZUTI<sup>3</sup> & CLELIA ROSSI-ARNAUD<sup>1</sup>; <sup>1</sup>Department of Psychology, Sapienza University of Rome (Italy); <sup>2</sup>PhD Program in Behavioral Neuroscience, Sapienza University of Rome (Italy); <sup>3</sup>Department of Dynamic and Clinical Psychology, Sapienza University of Rome (Italy)

**Background:** In the Attentional Boost Effect (ABE), stimuli encoded with to-be-responded targets are recognized more accurately than stimuli encoded with to-be-ignored distractors. Previous studies with young adults demonstrated that the ABE was eliminated by a moderate increase in the difficulty of the detection task. Since the maintenance of an accurate performance in visual oddball tasks requires more attention resources in older than in younger adults, we hypothesized that such an increase might equally reduce or eliminate the ABE in the older group.

**Method:** Younger and older adults encoded a sequence of stimuli (images in Experiment 1; words in Experiments 2) associated to either red (target) or green (distractor) squares. They were instructed to pay attention to the stimuli (incidental instructions) and simultaneously press the spacebar

whenever a target square appeared on the screen. After a 15-minute interval, memory for the encoded stimuli was tested in an old-new recognition task. Experiments 3 and 4 used verbal materials but either varied presentation time (from 500 to 1 s) or the nature of the instructions (intentional encoding). In addition, all participants were administered four subtests of the WAIS-IV tapping short-term memory and processing speed abilities.

**Results:** In all four experiments, the ABE was robust and significant in younger adults, whereas it was completely abolished in older adults. The two groups were equally accurate in the detection task. However, as expected, older adults performed worse than younger adults on the WAIS-IV short-term memory and processing speed subtests.

**Discussion:** Taken together, these data support the view that the ABE reflects a trade-off between attentional competition and attentional facilitation (Swallow & Jiang, 2010): in agreement, the age-related increase in the attentional demands of the detection task was sufficient to eliminate the memory enhancement observed in young adults.

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.. (3003) ..

**Functional brain imaging of working memory training: a meta-analysis.** JUHA SALMI<sup>1</sup>, LARS NYBERG<sup>2</sup> & MATTI LAINE<sup>3</sup>; <sup>1</sup>Åbo Akademi University, Finland, Department of Psychology, Faculty of Medicine, University of Helsinki, Helsinki, Finland; <sup>2</sup>Department of Integrative Medical Biology, Umeå University, Umeå, Sweden, Center for Functional Brain Imaging (UFBI), Umeå University, Umeå, Sweden, Department of Radiation Sciences, Umeå University, Umeå, Sweden; <sup>3</sup>Åbo Akademi University, Finland, Department of Psychology, Brain and Mind Center, University of Turku

**Background:** The topic of working-memory (WM) training has recently attracted great interest. While the behavioral effects of WM training have been meta-analyzed by several studies, the current evidence of the brain networks underlying WM training have not been pulled together. We conducted an activation likelihood estimation (ALE) based meta-analysis of the published fMRI data. Our specific aim was to delineate the training-induced changes in automatic and controlled processing on trained and untrained (transfer) WM tasks.

**Method:** Searches with PubMed, MedLine, PsychInfo, and Google Scholar for keywords "working memory", "fMRI", and "training" revealed a vast amount of hits of which 16 studies could be included to the study. Activations pre (187 foci, 320 participants) vs. post (372 foci) training, training-related activation increases (98 foci, 305 participants) vs. decreases (48 foci, 149 participants) reflecting changes in automatic and con-



trolled processing, and training effects for trained (167 foci, 372 participants) vs. untrained transfer (50 foci, 133 participants) tasks were analyzed with GingerALE2 software.

Results: Both trained and transfer tasks showed activation changes post training within three WM-related subnetworks. Sensory-motor network showed activation decreases, interpreted as more automatic low-level processing of trained and untrained tasks. Frontoparietal network showed activation increases and thus enhanced controlled processing primarily on the trained tasks. The prefrontal-subcortical network evidenced dorsolateral prefrontal cortex activity decrease and striatal/cerebellar activity increase in both trained and transfer tasks, taken as redistribution of task-relevant WM processing from cortical controlled processes to automatized subcortical processes.

Discussion: Our findings suggest that WM training modulates activity in widespread brain networks, however, reliable effects are observed only within the canonical WM networks. More specifically, WM training modulates large-scale brain networks by down-regulating low-level sensory-motor and higher-level prefrontal WM function, and up-regulating frontoparietal attention control and implicit subcortical functions. Near-transfer is observed across specific neurally overlapping WM component processes.

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.. (3004) ..

**Toward improving working memory capacity: A meta-analytic review.** AMINE HOSSEINI<sup>1</sup> & SALEHE PIRYAEI<sup>2</sup>; <sup>1</sup>refah university, Iran, Islamic Republic of; <sup>2</sup>Alzahra University, Tehran, Iran

Introduction: The cognitive literature related to memory and healthy young adults includes many facets of memory functioning and the young adults process. The major issues addressed in this study concentrate on the different methodological issues in research examining the effectiveness of memory valuable programs in improving memory performance of young adults along with the clinical implications of this kind of research.

Method: In the current review, publications were required to report original data on working memory valuable. All participants must be at least 16 years old at the time of training/intervention. Meta-analytic procedures were used to analyze retest-adjusted effect sizes from the systematic review. Study-specific effect size estimates were weighted by the analysis sample size and combined to form a standard effect size. Between-study heterogeneity was quantified using  $\chi^2$  and I<sup>2</sup> statistics. All analyses were performed utilizing the CMA version 2 software package.

Result: The combined effect size for detection

were 10.097 (CI: 9.788-10.446), respectively. Among them, Disengage is the best alternative/ correlate for working memory. Effect size with point estimate for fixed model is 0.589 (CI: 0.593-0.603) and for random model concludes 10.097 (CI: 9.788-10.4062). Disengage with the largest weight (23.30) defined as the most significant correlates in this review.

Conclusion: The key challenge of memory valuable studies related to cognitive performance interventions, is that they often don't train abilities that generalize to everyday functioning. Multifactorial interventions and use of technology, being the most effective predictors in the model, approaching statistical significance within the cognitive model. These results have numerous clinical and practical implications for future research and the development of therapeutic intervention programs.

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.. (3005) ..

**Integrating spatial information encoded from external viewpoints.** STELLA A. GEROU, STEPHANIE N. PANTELIDES & MARIOS N. AVRAAMIDES; *University of Cyprus, Cyprus*

The purpose of this experiment was to investigate whether people integrate visual and verbal spatial information encoded from different external points of view in a single memory representation at the time of encoding or they maintain separate representations until the time of retrieval, when integration benefits spatial reasoning. Participants memorized 3 visual and 3 verbal objects (i.e., they were given with verbal descriptions of the form "Imagine that a shoe is placed at 1 o'clock) from different external viewpoints and then executed pointing judgments that included objects from either the same (within – layout) or different (between – layout) layouts. Results indicated that pointing error and reaction time were lower for within – compared to between-layout judgments. Further analyses revealed that for the latency this was the case only for the first two block of trials while for the second two blocks participants were similarly fast across the two types of judgments. Overall, these findings suggest that in cases at which integration is difficult to occur at the time of encoding people keep separate representations and integrate only when integration is beneficial for spatial reasoning. Results are discussed in the context of recent theories claiming for multimodal integration.

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.. (3006) ..

**Cognitive Trainings of Executive Functions and Resistance to Visual Illusions.** HANNA BEDNAREK<sup>1</sup>, JAROSŁAW ORZECZOWSKI<sup>1,2</sup>, MAGDALENA PRZEDNICZEK<sup>1</sup>, RAFAŁ SZEWCZYK<sup>1</sup>, JUSTYNA OLSZEWSKA<sup>1,3</sup> & MICHAŁ ZIEMBOWICZ<sup>1</sup>; <sup>1</sup>*University of Social Sciences and Humanities, Warsaw, Poland, Poland*; <sup>2</sup>*Jagiellonian University*; <sup>3</sup>*University of Wisconsin Oshkosh*

Computerised cognitive trainings and their effectiveness have recently become a topic of strong interest and controversy. The aim of the study was to examine whether an intensive training of executive functions improves resistance to visual illusions. A total of 123 subjects, aged 19-31 (M=23.33, SD=2.65), participated in the pre- and post-test of executive functions with n-back, stop-signal and global-local trainings. In addition, to measure resistance to geometrical visual illusions Visual Illusion Simulation (VIS) was applied. Both, the experimental (N=61, 52.7% female) and the control (N=63, 48.2% female) groups completed 18 training sessions (40 min/day). Each training consisted of three practice tasks that are considered to improve updating, inhibition, and switching functions. The experimental group trained on an adaptive version of these tasks, while the control group completed a non-adaptive placebo training. The results revealed that the experimental group performed significantly better on all of the tasks, i.e. n-back, stop-signal and global-local which proves the efficacy of cognitive trainings. Moreover, we showed that susceptibility to Miller-Lyer visual illusion slightly diminished, which indicates that an intense cognitive training leads to improvement of basic perceptual processes.

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.. (3007) ..

**Anodal transcranial direct current stimulation of the left dorsolateral prefrontal cortex disrupts statistical learning.** ORSOLYA NOÉMI PESTHY<sup>1</sup>, KATA HORVÁTH<sup>1,2</sup>, CSENGE TÖRÖK<sup>1,2</sup>, BALÁZS TÖRÖK<sup>3</sup>, KAROLINA JANACSEK<sup>1,2</sup> & DEZSÓ NÉMETH<sup>1,2</sup>; <sup>1</sup>*Eötvös Loránd University, Hungary*; <sup>2</sup>*Hungarian Academy of Sciences*; <sup>3</sup>*Budapest Institute of Technology and Economics*

Background: Procedural learning is crucial in everyday life; it underlies the acquisition of motor, cognitive, as well as social skills. Although many studies focused on procedural learning, the subprocesses behind this type of learning are still less characterized. We investigated two different subprocesses: the statistical learning (learning based on probabilities) and the higher-order sequence learning (learning based on the sequential order of the stimuli). Previous studies highlighted the supporting role of the right dorsolateral prefrontal cortex

(DLPFC) in statistical learning; however, the role of the left DLPFC remained controversial. In the present study, we investigated the role of the left and right DLPFC separately in statistical learning and higher-order sequence learning.

Methods: 90 healthy young adults participated in our study divided into three groups (left and right DLPFC stimulated and sham/control groups). We used anodal transcranial direct current stimulation (tDCS) on the DLPFC during a probabilistic sequence learning task which allows us to separate statistical learning and higher-order sequence learning.

Results: Our results show that stimulation over the left DLPFC disrupted statistical learning compared to the control group, however, it had no effect on higher-order sequence learning. The right DLPFC stimulation groups' performance was comparable to that of the controls.

Discussion: Our results are in line with previous findings highlighting an interhemispheric asymmetry in the role of the DLPFCs in probabilistic sequence learning. We showed dissociation between statistical learning and higher-order sequence learning and that these processes involve different neurocognitive networks.

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.. (3008) ..

**Now you see me, now you don't: Chasing sequential dependencies in recognition memory judgments.** MARINA P GROSS; *Washington University in Saint Louis, United States of America*

Memory researchers typically assume that the trials of memory tests are independent: The outcome of trial n should not influence the outcome of trial n+1. However, recent research suggests recognition memory judgments are serially correlated: When an item is recognized as "OLD," the next item is more likely to be judged "OLD" rather than "NEW." Initially, we examined whether explicit expectations might cause the dependency. We asked participants to predict the study status of each upcoming memorandum. Although their predictions were heavily influenced by their immediately preceding memory judgments, the predictions themselves did not anticipate subsequent recognition responses. Moreover, this paradigm did not yield the expected serial correlations in recognition judgments (predictions aside). If it was predicting future memory that disrupted the serial correlation phenomenon, then we reasoned replacing predictions with a simple random button pressing task would reveal a robust serial correlation in the recognition judgments. However, when predictions were replaced with random button pressing, the data again failed to show any serial correlations between recognition judgments. A third experi-

ment fully removed the intervening task, and again demonstrated no appreciable sequential dependencies. Interestingly, prior work that showed robust serial dependencies has used a simultaneous confidence/classification judgment (e.g., high-new, low-new, low-old, high-old) whereas we used a two-step decision procedure in which memory classification (old/new) and confidence assessment (high, med, low) are separated. Therefore, our work shows that sequential dependencies in recognition judgment are a fragile phenomenon, and indicate they are minimal when confidence assessment and classification are not combined into a single decision.

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.. (3009) ..

**The influence of item similarity on metacognitive monitoring in simple and complex categorization tasks.** VALNEA ŽAUHAR, IGOR BAJŠANSKI & DRAŽEN DOMIJAN; *University of Rijeka, Croatia*

The aim of the study was to investigate the influence of item similarity on classification accuracy and confidence judgments in categorization tasks with two mutually exclusive categories defined by a simple or a complex rule.

Two experiments using pictorial stimuli that varied on five binary-valued dimensions were conducted. In Experiment 1 (N=71) stimuli were colored arrows presented on a background similar to those used by Waldron and Ashby (2001). In Experiment 2 (N=64) stimuli were drawings of imaginary animals adapted from previous studies by Regehr and Brooks (1993). In both experiments, participants were divided into two groups that learned either a simple task in which categories were separated by a one-dimensional rule or complex task in which categories were separated by a three-dimensional rule.

The experiments consisted of category learning and transfer phases. In ten learning blocks participants were asked to learn category memberships relying on feedback about the correctness of their responses. In the transfer phase, novel items that varied in similarity to items observed in the learning phase were introduced. Similarity was manipulated by altering one or two dimensions irrelevant for correct classification. Participants were asked to classify the presented items and to give confidence judgments about each classification.

The results of both experiments showed higher accuracy and confidence in simple tasks. Furthermore, in both tasks of Experiment 1 and in the simple task of Experiment 2 accuracy was not influenced by similarity to learned exemplars, while confidence increased as a function of similarity. The results suggest that metacognitive monitoring is influenced by task similarity even when simple one-dimensional rule is available for classification. In

the complex task of Experiment 2, accuracy and confidence increased as a function of item similarity suggesting that with more complex pictorial stimuli metacognitive monitoring relies on the same sources as classification decisions.

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.. (3010) ..

**Mechanisms driving the Mere Ownership Effect in memory: Evidence for Semantic Organization.**

JULIA VALERIE ENGLERT<sup>1,2</sup>, CHARLOTTE DIEKMANN<sup>1</sup> & DIRK WENTURA<sup>1</sup>; <sup>1</sup>Saarland University; <sup>2</sup>FernUniversität in Hagen, Germany

If an object is arbitrarily assigned to the self it is more likely to be remembered, typically shown by better recognition performance for self-versus other-assigned items (Mere Ownership Effect; Cunningham et al. 2008). A theoretical question is whether the Mere Ownership effect can be interpreted in a similar way as the classical Self-Reference Effect (Rogers, Kuiper & Kirker, 1977). This memory advantage produced by self-referential encoding is typically interpreted within the framework of Levels of processing theory (Craik & Lockhart, 1972) – as a result of “deeper” and more elaborate semantic processing during encoding.

Recent experiments by Englert & Wentura (2016) already revealed that “semantic processability” of the learning material appears to be a prerequisite for the Mere Ownership effect and that, similar to results in a self-reference task, ownership dominantly affects “remember” responses (in contrast to “know” responses). One mechanism that is thought to partially drive the Self-Reference Effect is semantic organization, i.e., the structuring of the to-be-learned material either by linking the individual stimuli with each other or by linking them to their superordinate categories (Einstein & Hunt, 1980; Klein & Kihlstrom, 1986). Such semantic organization should manifest itself in a greater likelihood for stimuli to be re-produced in close proximity to each other at retrieval (i.e., clustering) if free recall is used as the memory task. Using free recall in the mere-ownership paradigm, we obtained evidence for organisation: Objects that had been assigned to the self showed greater clustering than objects that had been assigned to another person (Englert & Wentura, 2016b).

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.. (3011) ..

**The influence of working memory load on memory for happy and angry faces.** MEIKE KRONEISEN; *University of Koblenz-Landau, Germany*

Facial identification is important because it informs us regarding how to react to an approach-

ing person, who might be friend or foe. In social situations, the emotional expressions of faces are important and very salient aspects of nonverbal communication. Previous work has shown that the facial expression (happy or angry) influences the memory of this face in a later recognition test.

D'Argembeau and Van der Linden (2007) suggested that facial identity is processed more elaborately and distinctively when faces display happy rather than angry expressions. In line with that, they found more remember than know responses for happy faces in comparison to angry faces. If elaboration and distinctiveness are essential for this effect, it should diminish when cognitive resources at encoding are scarce, for example, under working memory load. However, if this is an automatic effect, then one would expect to find this effect even under working memory load. To test this, we presented our participants facial photographs with different expressions. Half of our participants had to finish a concurrent working memory task at the same time. A later recognition test indicated that old-new discrimination but not source memory is affected by whether a face was presented with a happy or an angry expression. Interestingly, this effect was even more pronounced for the working memory load condition. This finding supports the idea that the influence of expressions on memory for facial identity occurs automatically.

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.. (3012) ..

**Fine grained visual representations contribute to the content of visual long-term memory.** REBECCA OVALLE FRESA & NICOLAS ROTHEN; *Institute of Psychology, University of Bern*

An ongoing debate in psychology and cognitive science concerns the nature of memory representations: are they purely semantic or also visual? In order to answer this question, we were seeking to manipulate the quality of visual long-term memory representations while keeping its accessibility consistent. We used a mixture modelling approach, which provides estimates for the probability of recall and the fidelity of the recalled representations, to assess long-term memory performance of 140 participants in an object-colour association task. During encoding, participants either reproduced the colour of an object in a simultaneous presentation scenario (i.e., perceptual condition) or reproduced the colour of an object in a delayed estimation scenario (i.e., working memory condition). Crucially, all participants were instructed to memorize the colours of the objects for a subsequent memory test (i.e., long-term memory). As expected, at encoding participants in the perceptual condition revealed enhanced fidelity compared to participants in the working memory condition. Interest-

ingly, and despite reduced fidelity at encoding, participants in the working memory condition showed enhanced long-term memory retrieval in comparison to participants in the perceptual encoding condition, while the probability of recall did not differ between the two conditions. The results imply that participants did not exclusively rely on verbal labels but also on fine grained internal visual representations.

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.. (3013) ..

**Verbal Labels in Working Memory? Memory for Colours and Shapes in Healthy Cognitive Ageing.** ALICIA FORSBERG, WENDY JOHNSON & ROBERT LOGIE; *University of Edinburgh, United Kingdom*

Visual Working Memory (WM) tends to decline more rapidly with ageing than verbal WM (Johnson, Logie & Brockmole, 2010). Recent research has investigated how features are bound in WM, and whether feature-binding is specifically impaired in healthy ageing. Following suggestions that older adults may tend to use verbal strategies to remember visually presented stimuli, we attempted either to facilitate or impede the use of such strategies experimentally.

We report three WM experiments comparing memory for easy- or difficult-to name colours and/or shapes in younger and older adults. In Experiment 1 we used an item-reconstruction paradigm, and found that memory accuracy was better for easy-to-name than for difficult-to-name items, in both age groups. Overall, memory accuracy was higher for younger than for older adults, and this difference between groups was significantly larger for difficult-to-name colours. However, the older adults performed as well as the young adults for easy-to-label colours. These results are consistent with higher reliance on verbal memory strategies by the older adults. However, such an age-related benefit for easy-to-label items was not observed for shape memory. In Experiment 2, the benefit for older adults with easy-to-name colours was replicated, but this benefit was reduced under Articulatory Suppression, suggesting the effect was partly due to sub-vocal rehearsal of colour names. In Experiment 3, we used a change-detection paradigm, and while overall memory was more accurate for easy-to-name items, no age differences were found in accuracy.

These findings might explain some discrepancies in previous feature-binding research; if some experiments permit verbal strategy use, this might boost older adults' accuracy in the single-feature condition, which (when compared to accuracy in a binding condition where verbal strategies are less efficient) could appear as a feature-binding deficit in older adults. We suggest that ease of stimulus-

labelling should be considered when designing future studies.

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.. (3014) ..

**Semantic Similarity Finally Interact With Serial Order Processing In Short-Term Memory.** BENJAMIN KOWIALIEWSKI<sup>1,2</sup>, SIMON GORIN<sup>1</sup> & STEVE MAJERUS<sup>1,2</sup>; <sup>1</sup>*University of Liège, Liège, Belgium*; <sup>2</sup>*Fund for Scientific Research, F.R.S.-FNRS, Brussels, Belgium*

**Background:** Verbal short-term memory (VSTM) is a cognitive function allowing the temporary storage of linguistic information. This function strongly rely on stored long-term memory (LTM) knowledge: verbal items associated with richer LTM representations are better recalled in VSTM. These LTM aspects are generally considered as being independent from serial order processing, that is, the ability to maintain the order in which verbal items appear within a sequence. The purpose of this study was to demonstrate that serial order processing in VSTM can also interacts with LTM knowledge, focusing more specifically on the interactions with semantic knowledge.

**Method:** Forty participants performed a VSTM task in which they were invited to listen and recall in the correct serial order lists composed of 6 words; verbal lists were either semantically related or they were not. The words were grouped by groups of 3 semantically related words (e.g. three, leaf, branch, cloud, sky, rain) in the related condition.

**Results:** We observed no effect of semantic grouping on the proportion of order errors. However, semantic grouping dramatically influenced the pattern of transposition errors: while statistically less inter-group transpositions (i.e. erroneously recalling one item from one semantic category to another) were observed in the related condition, we also observed statistically more intra-group transpositions (i.e. transposing two items within the same semantic category).

**Discussion:** These results show that semantic knowledge can influence serial order processing in VSTM. They also support recent theoretical proposals stating that serial order processing strongly interact with the activation within the semantic system.

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.. (3015) ..

**Time to process information in working memory improves episodic memory.** ALESSANDRA S. SOUZA & KLAUS OBERAUER; *University of Zurich, Switzerland*

In simple-span tasks, participants encode items sequentially for immediate serial recall. Complex-

span tasks are similar, except that items are interleaved with a distraction task. Whereas immediate memory is higher in simple than complex span, in tests of episodic long-term memory, better recall for words studied in complex than simple span was observed (McCabe, 2008). This McCabe effect was explained by assuming that distraction displace items from working memory, forcing people to covertly retrieve items after each distraction, thereby generating better episodic retrieval-cues than during simple span. Our experiments support an alternative hypothesis: individual words are attended to and processed longer in working memory in complex-span than in simple-span trials. We reduced the presentation rate of words in simple span, creating a "slow span" condition. Across four experiments, slow span improved episodic memory compared to simple span, and this benefit was larger than the McCabe effect.

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.. (3016) ..

**Do older adults show the encoding enactment advantage for following instructions in working memory?** RACHEL O COATS, AMANDA H WATERMAN, FIONA RYDER & RICHARD J ALLEN; *University of Leeds, United Kingdom*

Recent working memory research examining the ability to follow verbally presented sequences of instructions has shown that enactment during encoding (via self-enactment or demonstration) improves verbal recall performance in young adults (e.g., Allen & Waterman, 2015; Yang, Allen, Yu & Chan, 2015). Research on following instructions in older adults is limited, and it remains to be seen whether the same enactment advantages occur. In the present study young adults (aged 18-22 years) and older adults (aged 60-81 years) listened to sequences of instructions containing action-object pairs (e.g., push the cross) increasing in length from 3 pairs to 5 pairs. Participants were required to immediately verbally recall the full sequence of instructions in its original order. The process was repeated but with participants also self-enacting the instructions (self-enactment condition) or observing the experimenter demonstrate the instructions (demonstration condition). Order of the 3 conditions was counterbalanced. Young adults' recall of instruction sequences was significantly higher than older adults' recall. Demonstration at encoding significantly improved the performance of both groups, whereas self-enactment boosted the younger adults' performance but not the older adults' indicating that, for older adults, the enactment advantage is absent when the enactment is self-generated. This is perhaps due to the added complication of producing the correct movements. The possible application of these res-

ults to applied contexts will be discussed, for example, advice for doctors supplying prescription-taking guidelines.

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.. (3017) ..

**Longer presentation times affect performance but the acquired knowledge: Evidence from an implicit probabilistic sequence learning task.** MARI-ANN KISS<sup>1</sup>, DEZSO NEMETH<sup>2,3</sup> & KAROLINA JANACSEK<sup>2,3</sup>; <sup>1</sup>*Department of Cognitive Science, Budapest Institute of Technology and Economics, Budapest, Hungary, Hungary;* <sup>2</sup>*Institute of Psychology, Eötvös Loránd University, Budapest, Hungary;* <sup>3</sup>*MTA-ELTE NAP B Brain, Memory and Language Research Group, Institute of Cognitive Neuroscience and Psychology, Research Centre for Natural Sciences, Hungarian Academy of Sciences, Budapest, Hungary*

Previous studies have shown that longer stimulus presentation times affected learning and led to more explicit knowledge in deterministic sequence learning tasks. However, the effect of longer presentation times in the case of probabilistic sequences remains elusive. Here we aimed contrast learning with longer vs. shorter presentation times and test whether the acquired knowledge itself or only the performance differs between these conditions. We used the Alternating Serial Reaction Time task (ASRT) to measure probabilistic sequence learning with systematically manipulating the Response-to-Stimulus-Interval (RSI). Participants (N = 79) were assigned to a short (120 ms RSI) or a long (850 ms RSI) group during the Learning Phase, and were tested 24 hours later both with the practiced RSI and the unpracticed RSI (congruent vs incongruent conditions). Their explicit knowledge was assessed by the process dissociation procedure (PDP). We found that the 120 RSI group showed better performance in the Learning Phase compared to the 850 RSI group. In the Testing Phase, however, switching to the longer presentation time (850 ms) disrupted the 120 RSI group's performance while switching to a shorter presentation time (120 ms) did not affect the 850 RSI group's performance. The PDP procedure showed that the knowledge remained implicit with no difference between groups. Our results highlight that on competence level longer stimulus presentation times do not affect the acquired knowledge and its implicitness but lead to a weaker performance level. These findings can help deepen our understanding regarding the underlying mechanisms and time course of sequence acquisition and performance issues.

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.. (3018) ..

**The Role of Working Memory on False Memories and Individual Differences.** EDA BAĞCI & HASAN GÜRKAN TEKMAN; *Uludağ University, Turkey*

Background:

There is research showing a relation between working memory capacity (WMC) and frequency of false memories in the Deese-Roediger-McDermott (DRM) paradigm. One explanation for this relation is a mediating effect by the source monitoring processes between these two variables. The purpose of this study was to examine the relationship between working memory, source monitoring and false memory processes within the framework of individual differences. The direct effect of working memory capacity on false recognition and indirect effect of working memory capacity through source monitoring were investigated.

Method:

One hundred undergraduate students were tested using the DRM paradigm, a source monitoring task and operation span task.

Results:

Working memory capacity was not related to false recognition or source monitoring. However, source monitoring was related to false recognition. False recognition, in turn, was positively related to correct recognition, which was positively related to WMC.

Discussion:

In this study, although source monitoring had an effect on false recognition, WMC did not have a direct effect or an indirect effect through source monitoring on false recognition. But WMC had an indirect effect through remembering more studied words on false recognition (a "more is less" pattern). Higher correct remembering and poorer source monitoring seems to be indicators of false memories.

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.. (3019) ..

**The relationship between initial confidence and subsequent eyewitness suggestibility.** LIANA TKATCH<sup>1</sup>, AINAT PANSKY<sup>1</sup> & JASON C.K. CHAN<sup>2</sup>; <sup>1</sup>*University of Haifa;* <sup>2</sup>*Iowa State University*

Numerous studies have shown that exposing eyewitnesses to misleading information about the witnessed event can alter their memory of event details. Several studies have successfully used initial testing, which has been previously shown to enhance the retention of the tested items, as a means by which to inoculate eyewitnesses against such misleading suggestion (e.g., Pansky & Tenenboim, 2011). However, other studies have obtained the opposite finding, in which testing witnesses after an event actually made them more suggestible in

what is known as Retrieval-Enhanced Suggestibility (RES; Chan, Thomas, & Bulevich, 2009).

In the present study, we used the standard RES paradigm to examine the extent to which susceptibility to misleading suggestion is influenced by one's initial confidence in the correctness of the retrieved information. After viewing a target event, participants were tested (or not) on event details. They were then exposed to misinformation about some of those details. Finally, they completed an additional cued recall test, followed by a discrepancy recollection task. Assuming that eyewitnesses tend to rely on their own memories when they are confidently held, less suggestibility would be expected for such items compared to those that are associated with lower confidence. However, according to the phenomenon of hypercorrection, whereby high confidence errors are more readily corrected by feedback than low confidence errors, obtaining the opposite pattern of results would also be possible.

As predicted, we found that responses that were held with high confidence were more immune to later suggestion than responses held with low-to-medium confidence. Participants were also more likely to recollect discrepancies between the target event and the post-event information for items they had initially retrieved with high confidence. Although a RES effect was obtained overall, it applied mostly to low-to-medium confidence items. The role of discrepancy detection in influencing RES will be discussed.

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### Poster Session III

#### S13, Tuesday, 10:40 – 12:00

.. (3301) ..

**'Stop it and do something else' - cognitive fatigue as a signal to change the course of action (in the context of self-control)** NATALIA WÓJCIK & MICHAŁ NOWAK; *Jagiellonian University, Poland*

Presented study is based on a Berkman's et al. (2015) assumption that self-control is a value-based decision making process which results in choosing a 'self-controlled' course of action from several alternatives. This process involves calculating a value for each option by integrating various gains and costs (effort, opportunity costs) and enacting the most valued option. Self-control is usually connected with subjective feeling of effort and strain as opposed to indulging, so probably its value is reduced at the starting point of a decision making process. The aim of our research was to examine whether the subjective feeling of cognitive

fatigue is related to the task performance and effort when participants (N=80) are situated in the context of self-control dilemma. Participants were told that they were going to participate in a training of cognitive abilities, they completed NAS-50 (self-control trait scale) and then were randomly assigned to one of two experimental groups: Easy Tasks (e.g. N-back – 2-back) and Hard Tasks (e.g. 5-back). Each group performed a maximum of 30 tasks that engaged cognitive control processes. Participants were informed that the longer they would put their effort on those tasks, the longer the results of the training would last. After each block participants answered several questions including ones about their subjective feeling of cognitive fatigue and had to decide whether they wanted to perform the next task or finish the training - therefore participants could resign after each task. The results are under analysis and will be discussed in the light of Hockey's (2010, 2013) theory which implies that cognitive fatigue is an adaptive state that signals decreasing utility of ongoing behavior in relation to other potential activities.

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.. (3302) ..

**Global versus analytical cognitive style and personality traits as the correlates of mindreading ability.** ADAM PUTKO, AGATA ZŁOTOGÓRSKA-SUWIŃSKA, MARTA ANDRZEJEWSKA & ANNA MISIASZEK; *Adam Mickiewicz University in Poznań, Poland*

The aim of the study was to examine the relationship between a global vs. analytical information processing style, personality traits and mindreading ability. Based on the assumptions of the weak coherence account (Happé & Frith, 2006) and the results of previous studies, it has been hypothesized that mindreading ability would be related to a global cognitive style and to Agreeableness as a personality trait (Nettle & Liddle, 2008). Seventy-two adults aged 19-43 years participated in the study. Witkin's EFT was used as a measure of global vs. analytical cognitive style and the NEO-FFI questionnaire (Costa & McCrae, 1992) as a measure of the Big Five personality traits. Mindreading ability was assessed with The Movie for the Assessment of Social Cognition (MASC, Dziobek et al., 2006) and tasks requiring high level recursive mental states reasoning (O'Grady et al., 2015). Multivariate regression analysis showed that, after accounting for age, the recognition of emotional mental states (as indexed by a subscale of the MASC test) was related to an analytical style, whereas the recognition of cognitive states to Conscientiousness (a negative relation). Two measures of recursive mental states reasoning - answers to test and control memory questions - were significant.

antly predicted by an analytical style and Agreeableness, respectively. The results are inconsistent with the weak coherence account, indicating some links between various mindreading skills and an analytical cognitive style rather than a global one. It also appears that some personality factors are independent correlates of mindreading skills, raising questions about common and unique mechanisms that underlie mindreading processes and behavioural dispositions manifested in personality traits. Email: adam.putko@amu.edu.pl

.. (3303) ..

**Cues and deadlines to elicit the speed-accuracy trade-off: A reanalysis of three published experiments.** DIMITRIS KATSIMPOKIS<sup>1</sup>, GUY HAWKINS<sup>2</sup> & LEENDERT VAN MAANEN<sup>1</sup>; <sup>1</sup>*Department of Psychology, University of Amsterdam, the Netherlands;* <sup>2</sup>*Australian Research Council, School of Psychology, University of Newcastle, Australia*

Many studies have used a range of methods to elicit the trade-off between accurate responses and speedy decision-making. Some have used cue-based methods in which participants receive a cue that states they should focus either on accurate or fast responding. Other studies have used response deadlines, while some have made a mixture of the two. However, recent literature suggests that these two manipulations target qualitatively different cognitive processes. While the speed-accuracy trade-off paradigm has led to a better understanding of the cognitive mechanisms underlying decision-making under time pressure, in the current study we investigated whether expected deadline effects can be found in behavioral data elicited under cue-based manipulations.

In a series of re-analyses of three previously published experiments, we searched for the behavioral signatures of deadlines by looking at the skewness of the Reaction Time distribution and the slope of Conditional Accuracy Functions. The results provide some evidence that (1) skewness decreases in speed-focused conditions and (2) the second half of Conditional Accuracy Functions is steeper in speed-focused conditions, both of which are indications of deadlines being involved in the decision-making process.

These results have practical implications for the design of experiments studying decision-making as an evidence accumulation process towards a threshold value. In particular, consistent with previous work, the cue manipulation seems to affect the overall level of the threshold. In contrast, the deadline manipulation seems to affect the speed with which participants adjust this threshold within a trial, sometimes referred to as decision urgency.

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.. (3304) ..

**Investigation of Eye-hand Coordination during Adaptation to a Novel Visuomotor Rotation Task: an Eye-tracking study.** AÇELYA YILDIZ<sup>1</sup>, HAKAN ÇETINKAYA<sup>2</sup>, SEDA CAN<sup>1</sup>, SEDA DURAL<sup>1</sup> & GAZİHAN ALANKUŞ<sup>1</sup>; <sup>1</sup>*Izmir University of Economics, Turkey;* <sup>2</sup>*Ankara University, Turkey*

The present study, supported by TUBITAK, utilized an Eye Tracking device to investigate the changes in eye-hand coordination during adaptation to a novel visuomotor rotation task. In addition to traditional linear visuomotor mapping rule previously encountered in literature, in this study, a circular visuomotor mapping rule was created and presented. The sampling of the study consisted of 32 college students and lecturers all of whom were right-handed, healthy participants who had normal vision. The motor task required participants to move from a starting point with a computer mouse and to hit fifteen targets located around an imaginary circle, during which a rotation manipulation was employed on the mouse's trajectory with an angle of 45 degrees. In circular condition, unlike linear condition, straight movements resulted in circular tracks. Eye-hand coordination was investigated based on local components determined as time interval between first eye fixation on target and target hit (eye-to-shooting latency), time interval between first eye fixation on target and arrival of cursor on target (eye-to-hand latency), time interval between arrival of cursor in target area and target hit (hand-to-shooting latency), and time interval between first eye fixation on target and first eye fixation on the next target (eye-to-eye latency). Growth curve analysis was conducted on gradual changes related to trial completion length and local components of eye-hand coordination. Trial completion length across five trials indicated decreased movement error and increased precision. Eye-to-shooting latency was significantly higher in circular condition compared to linear condition, indicating that participants in circular condition took longer time to hit the target after visually detecting it. Eye-to-eye latency was longer in circular condition suggesting that the foveal movement towards the next target took longer in circular condition and that the predictive role of visual guidance was relatively delayed in circular condition compared to linear condition.

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.. (3305) ..

**Unfamiliar face identification requires more than two fixations.** ALEJANDRO J ESTUDILLO, NARMATHA ANPARASU, AKILA RUBAIYA HAQUE PURNA & NEIL MENNIE; *University of Nottingham Malaysia Campus, Malaysia*

Unfamiliar face identification is a challenging



task for our visual system. However, previous research has shown that two fixations might suffice to solve this task. In that study, however, the faces presented at study and test stages were identical, which might index general image recognition processes rather than face-specific recognition processes. In this study, we have tried to dissociate these processes using eye-tracking. In a face-recognition paradigm, participants were allowed to do a variable number of fixations before the face disappeared. Some of the faces were identical to those studied in the study stage (same condition) while others depicted a different picture of the same studied identity (different condition). Results showed that although two fixations were enough to achieve near-to-optimal performance in the same condition, performance in the different condition were at chance levels across the entire fixation range. These results demonstrate that unfamiliar face recognition is a highly-demanding task. Email: alejandro.estudillo@nottingham.edu.my

.. (3306) ..

**Opportunity Costs and the Sensation of Effort in Executive Function Tasks.** MICHAŁ NOWAK, EDWARD NECKA & NATALIA WÓJCIK; *Jagiellonian University in Kraków, Poland*

The sensation of effort accompanying executive function tasks performance is suggested to be the result of the computation of costs and benefits of performing a given task. In the opportunity costs model of self-control the appearance of effort and the subsequent decision to continue or abandon the current task is postulated to be dependent on the computation of benefits of the next best use of the same cognitive processes and the costs of continuing the task at hand. However, the data on the significance of the opportunity costs as the causal factor in the appearance of subjective sensation of effort is scarce. We set out to assess whether the presence of the subjective sensation of effort is dependent on the presence and level of the opportunity costs of continuing a given task. The participants (N=90) were randomly assigned to two experimental groups and a control group. Each group performed an identical set of executive function tasks. We employed a self-report approach to effort assessment and controlled the opportunity costs level via manipulations of the salience of the information about alternative uses of executive function – subjectively valuable (Experimental Group 1) and aversive (Experimental Group 2) activities. The control group performed the executive function tasks and received neutral information. The level of trait self-control and need for cognition was controlled for in the study. The results will be discussed in the context of the ongoing discussion between the proponents of motivational

and resource models of effort and self-control. Email: mich.nowak@uj.edu.pl

.. (3307) ..

**The Influence of Stress on “wanting” and “liking” for Sweet and Savoury Food: The Effect of Gender.** NEZAHAT DEVECİ & BURAK ERDENİZ; *Izmir University of Economics, Turkey*

Previous studies showed that two components of reward system the ‘wanting’ and the ‘liking’ are generally correlated but can be distinguishable from each other under certain circumstances. The aim of the present study is to distinguish these two systems using stress manipulation. ‘Wanting’ behavior was assessed by a forced choice paradigm, whereas ‘liking’ behavior, by pleasantness rating of rewarding stimuli. We used two types of food categories, savoury and sweet, which were further divided into high and low calorie food categories. Thirty-six female and twenty-six male participants who had not eaten for at least three hours were equally divided into either the stress condition or the non-stress condition. The results showed no significant difference for the ‘liking’ ratings between the stress group and non-stress group for either sweet or savoury food categories. However, statistically significant difference was found for ‘wanting’, participants in the stress group wanted high calorie sweet food more than participants in the non-stress group, and participants in the non-stress group wanted high calorie savoury food more than participants in the stress group. Moreover, the effect of gender on ‘wanting’ and ‘liking’ was examined in the scope of present study. We did not find effect of gender on ‘wanting’, however males and females differ in their ‘liking’ ratings for sweet and savoury reward. Males liked savoury food more than females but females liked sweet food more than males.

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## Poster Session III S14, Tuesday, 10:40 – 12:00

.. (3401) ..

**In colore veritas? Investigating automatic color-validity associations with a Stroop paradigm.** LENA NADAREVIC, SUSANNE GEBHARDT, MARIE-SOPHIE GRÖGER & NIKOLETTA SYMEONIDOU; *Universität Mannheim, Germany*

Colors are not only perceptual stimulus features but also carry meaning. The goal of the present study was to investigate whether people automatically associate green statements with the attribute

true and red statements with the attribute false. We tested these predicted color-validity associations by means of a Stroop task. Stimuli in the Stroop task were true statements (e.g., “tables are furniture”) and false statements (e.g., “bananas are buildings”) that were displayed in two different colors depending on the experimental condition. Colors were green and red (condition 1), green and gray (condition 2), or red and gray (condition 3). Red and green varied in hue but not in chromatic intensity. Moreover, all colors were matched on lightness. The participants’ task was to classify each statement as true or false and to do so as fast and as accurately as possible. We expected that participants would perform best when responding to true statements presented in green and to false statements presented in red. However, this prediction was only supported when green and red statements were presented within the same experimental condition (condition 1) and when participants had to provide speeded responses due to an adaptive response deadline. In contrast, color did not affect the accuracy and latency of validity judgments when green and red statements were presented in the context of gray statements (conditions 2 and 3) and when there was no adaptive response deadline that enforced speeded responses. Taken together these findings suggest that automatic color-validity associations are context dependent.

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.. (3402) ..

**Statistical variance lowers cue weighting during acoustic cue acquisition: a GAMM model of eye movement data.** JESSIE SOPHIA NIXON<sup>1</sup> & CATHERINE T. BEST<sup>2</sup>; <sup>1</sup>*New Zealand Institute of Language, Brain & Behaviour (NZILBB), New Zealand*; <sup>2</sup>*MARCS Institute, Western Sydney University, Australia*

**Background.** Speech perception uses continuous (nondiscrete) acoustic cues to discriminate between discrete alternative messages (e.g. words). Yet the organisation of acoustic cues differs substantially across languages. How do listeners know which cues to attend to? Recent research shows that native listeners adjust cue weighting according to cue variance (Clayards et al., 2008; Nixon et al, 2016). The present study extended this investigation to non-native acquisition.

**Method.** In a ‘visual world’ eyetracking experiment, participants saw four pictures of objects and heard a word. Their task was to click on the picture of the word. Target and competitor images were of word pairs that were identical except for tone. Auditory stimuli were words in a 14-step pitch continuum presented in a bimodal, approximately Gaussian distribution. Acoustic variance differed between participants: high- vs. low-variance. Feedback (‘correct’/‘wrong’) was given on each trial.

**Results.** Euclidean distance of fixations from target was analysed using generalised additive mixed models (GAMMs; Wood, 2006). Models showed a significant condition-by-pitch nonlinear interaction over time (continuous variable;  $p < 0.001$ ); and a significant condition-by-pitch nonlinear interaction over the course of experiment (continuous variable; i.e. learning;  $p < 0.001$ ). Two distinct patterns of results emerged between conditions. In the low-variance condition, fixations were initially closer to target at lower pitch values. Pitch over time was not significant in the high-variance condition ( $p > .5$ ). By halfway through the experiment, fixations in the low-variance condition were closer to target than in the high-variance condition.

**Discussion.** These results provide evidence that in implicit statistical learning of new cue dimensions, too much within-category cue variance hinders acquisition; the ideal learning condition is with low variability in the contrastive dimension. In the low-variance condition, participants were better able to utilise feedback from prediction error to increase weighting of an acoustic cue that was not predictive in their native language.

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.. (3403) ..

**Individual differences in preference for curvature.** MANUEL BELMAN<sup>1</sup>, GUIDO CORRADI<sup>1</sup>, TOMMASO CURRO<sup>2</sup>, MARCOS NADAL<sup>1</sup>, JAUME ROSSELLÓ<sup>1</sup> & ENRIC MUNAR<sup>1</sup>; <sup>1</sup>*University of the Balearic Islands, Spain*; <sup>2</sup>*Università degli Studi di Firenze*

People tend to prefer objects with curved contours to objects with sharp contours (Bar & Neta, 2006; Palumbo & Bertamini, 2016). Nevertheless, as with other aesthetic features (Jacobsen, 2004), there are also considerable differences among people in the extent to which they prefer curvature. The aim of the research presented here was to explore the possible reasons for such differences. Specifically, we sought to determine whether individual differences in preference for curvature were explained by participants’ interest in art, studies, openness to experience, intelligence or sex. Thus, we asked 56 participants to perform a 2AFC preference for curvature task (Munar, Gómez-Puerto, Call & Nadal, 2015), answer questions of a Visual Art Interest and Education Scale (VAIES), Raven’s intelligence test and answer the openness to experience scale from the NEO-PI-R (Costa & McCrae, 1992). Linear mixed effects modeling was used to predict participants’ preference for curvature using their experience with art, openness to experience, intelligence scores, studies, and sex as predictors. We found that openness to experience and sex had a significant negative effect on the probability of choosing the curved alternative and that

the probability of choosing the curved alternative was higher for women than for men. The effect of openness is weaker for art students than for others. These results are discussed in terms of the multiplicity of cognitive and affective processes contributing to aesthetic appreciation (Leder & Nadal, 2014).  
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.. (3404) ..

**Impaired Social Implicit Learning in Autism Spectrum Disorders (ASD).** SYLWIA MACINSKA & TJEERD JELLEMA; *University of Hull, United Kingdom*

**Background:** Social implicit learning plays a significant role in guiding social interactions; on the basis of accumulating social cues people tend to adjust their behaviour to the current situational demands, even in the absence of explicit knowledge of social contingencies. Given the relevance of implicit learning for social functioning, a link has been hypothesised between ASD and implicit learning deficit. Yet, studies of implicit learning in ASD provide inconsistent results. Implicit learning however, is not a generalised ability and can be found either intact or impaired depending on the type of the information to be learnt, which could explain the discrepancy found in previous studies.

**Methods:** A novel implicit learning paradigm was used to assess differences in implicit memory formation of social and non-social information in typical development and in ASD. Participants were required to watch videos of two actors, whose facial expressions and gaze directions changed dynamically (social condition) and of two geometric objects, of which the colour and an internal shape changed dynamically (non-social condition). Both conditions conveyed hidden contingencies that could be learned implicitly and were matched in terms of difficulty and number of cues.

**Results:** The results suggested that implicit learning had occurred, with participants' responses biased in accordance to the implicitly learned contingencies. However, in the social condition this learning was only evident in typically-developed participants, with autistic participants showing a reversed pattern of results. No difference in implicit learning was found in non-social condition with both groups learning equally well.

**Discussion:** These findings open up the possibility that atypical social cognition observed in individuals with ASD may partly result from impairments in implicit social learning. Although the lack of implicit social learning may be compensated for through deliberate reasoning about others' intentions, the use of such effortful cognitive processes would slow down social understanding.

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.. (3405) ..

**Lateralised Whorf - Evidence for categorical perception of colour in a Simon-like task.** STEVEN SAMUEL; *University of Cambridge, United Kingdom*

In recent years evidence has emerged that suggests we are faster to locate an 'oddball' colour in an array if that colour is different not only perceptually, but also in linguistic category. This outcome has tended to be strongest in, or even unique to, stimuli presented in the right visual field, and hence in receipt of privileged processing by language regions of the brain in the left hemisphere. I present evidence that the categorical perception of colour extends to a speeded-response, conflict-type task, in which two blues and two greens are each mapped to one key. For English speakers, each blue is 'blue', and each green 'green', but for Greek speakers a change in blue represents a categorical shift based on the basic colour terms of their native language. I found that when a change was perceptual but not categorical, participants were slower to repeat a response when that change was not supported by linguistic information in the left hemisphere compared to when the stimuli were first processed in the right hemisphere. For the Greek speakers who clearly made the distinction between each blue in a free-choice naming task, a categorical change in blue presented in the right visual field (and hence left hemisphere) was facilitated relative to matched trials in the left visual field. For Greek speakers who did not freely label each blue according to distinct and basic colour terms, no such lateralisation effect was found. However, subtle performance differences between blues and greens in the English speakers suggest that changes in blue were perhaps more perceptually distinctive, regardless of language. Overall, the evidence suggests that processing of change is facilitated when the change is matched by a concomitant change in linguistic category, or when such categories are partially 'bypassed' by presenting stimuli to the right hemisphere first.

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.. (3406) ..

**Older adults' emotion recognition ability unaffected by stereotype threat.** LIANNE ATKINSON, JANICE MURRAY & JAMIN HALBERSTADT; *University of Otago, New Zealand*

Reminding individuals about the stereotypes of a group to which they belong can impair their performance on relevant tasks. One group shown to be vulnerable to stereotype threat is older adults. Research has demonstrated that eliciting aging stereotypes (e.g., that cognitive abilities decline with age) leads to poorer performance on physical, memory, and cognitive tasks in adults aged over 65. The aim of this study was to see whether stereotype

threat impacts emotion recognition ability, a cognitive skill shown to decline with age. Young adults aged 18-30 and older adults aged over 65 completed an emotion recognition task that involved labelling individually-presented young and older faces displaying expressions of disgust, fear, anger, happiness, and sadness. They did this under one of three stereotype threat conditions: 'older threat' (study information included statements like "it is widely believed that emotion recognition ability decreases with age"), 'young threat' (e.g. "it is widely believed that emotion recognition ability increases with age") and 'control' (no reference to age differences). After the task, participants rated how threatened they were during the experiment on a scale of 1-7 (e.g., "Were you worried that your ability to perform well on these tasks was affected by your age?"). Consistent with previous findings, older adults' emotion recognition accuracy was worse than young adults for anger (young faces only), fear (regardless of face age), and happiness (old faces only). In addition, both young adults' and older adults' self-reported threat was higher in the condition in which their age group was stereotype-threatened than in the control condition, suggesting that the stereotype threat manipulation was effective. However, this perceived threat did not impact emotion recognition performance in either age group. This suggests that unlike other cognitive abilities, emotion recognition in older adults may be impervious to the negative effects of aging stereotypes.

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.. (3407) ..

**Understanding Emotions: Emotion Identification From Facial and Prosodic Clues.** AMÉLIE PAVARD, ALINA-ALEXANDRA SAVA & CHAINAY HANNA; *Université Lyon 2 - Laboratoire EMC, France*

What clues are relevant to identify emotions? Previous researches have explored emotion identification by using static stimuli such as photographs of human faces with emotional expressions (Oberman et al., 2007). However, some studies highlight the fact that some emotions are better identified when prosodic clues, rather than facial clues, are presented (Scherer et al., 2003). The purpose of our studies was to explore the mechanisms of emotion identification from an ecological point of view, by using both prosodic and facial modalities as emotional expressive clues; and to compare emotion identification from actors' and non-professionals' videos.

In Study one, two professional actors were filmed while pronouncing five neutral sentences with six basic emotions (happiness, sadness, anger, fear, disgust and surprise) and the neutral expression. In Study two, nine persons had to pro-

nounce neutral sentences after an emotion induction design, and then to perform two basic emotions (happiness and sadness) and the neutral expression. Twenty-four healthy young participants in each study were asked to identify the emotions expressed in an "auditory condition" (only voice), in a "visual condition" (video without sound), and in an "auditory-visual" condition (original video). The facial and prosodic (vowel length, absolute intensity, and fundamental frequency) clues were analyzed and quantified with Ekman's Facial Action Coding System – FACS, and with Praat software, respectively.

As expected, our results showed a better identification of emotions in the "auditory-visual" condition in both studies. Nevertheless, the emotion\*condition interaction showed specific tendencies, some emotions being better identified in the "visual" condition, in the "auditory" condition, or only one modality, whatever facial or prosodic. As far as the facial clues are concerned, the analyses are in progress. In conclusion, our results provide interesting avenues to the understanding of emotion identification mechanisms, and might be particularly useful to develop remediation programs of emotional identification and/or expression.

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## Poster Session III S15, Tuesday, 10:40 – 12:00

.. (3501) ..

**Improving spatial thinking using instructional videos: Exploring the benefits for both spatial and mathematics performance.** KATIE A GILLIGAN<sup>1</sup>, MICHAEL S.C THOMAS<sup>2</sup> & EMILY K FARRAN<sup>1</sup>; <sup>1</sup>UCL, United Kingdom; <sup>2</sup>Birkbeck, University of London

There is convincing evidence that spatial skills are both longitudinal and concurrent predictors of mathematics in children aged 5-10 years. Given these associations, this study investigates the effectiveness of instructional videos as a novel method for improving spatial skills and subsequently mathematics performance in children. These instructional videos aim to teach mental rotation and spatial scaling. This study adopted a randomised control trial design. The use of instructional videos as a spatial training tool was compared to traditional spatial training (practice with feedback) and to control conditions (no spatial training). Secondly, mental rotation training was compared to spatial scaling training. These spatial measures were selected as they have been identified as important predictors of mathematics achievement for children aged

6-8 years. Finally, to investigate the role of delivery mode on training efficacy, home-based participation, under parental supervision was compared to school-based participation under researcher supervision.

This study included 500 participants aged 6-8 years. Participants completed a battery of spatial and mathematics measures both pre, and immediately post-training. These measures included: a spatial scaling task; a mental rotation task; a number-line estimation task; a missing box calculation task and a geometry task. Findings from pilot data indicate significant improvements in mental rotation following training with instructional videos compared to control conditions ( $N = 28$ ,  $p < .05$ ,  $d = .153$ ). Data collection will finish in June 2017, after which, mixed ANCOVA will be used to further investigate the effects of training type, delivery mode, age, and participant engagement levels, on spatial and mathematics performance. This study will demonstrate whether instructional videos offer a fast, effective method of training spatial thinking, and whether this has knock on improvements in mathematics.

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.. (3502) ..

**The numerical magnitude system influences the retrieval of multiplication facts.** DANIELE DIDINO & ANDRÉ KNOPS; Humboldt-Universität zu Berlin, Berlin, Germany

The cognitive mechanisms underpinning arithmetic fact retrieval remain debated. Here, we investigated the functional relationship between the multiplication fact memory (MFM, i.e., the memory system that stores multiplication facts) and the approximate number system (ANS, i.e., the analogue magnitude representation of numerical quantities). We provide new evidence in favour of the hypothesis that the compressed metric of the ANS (i.e., the overlap between the representations of two adjacent numbers increases as the magnitude of the numbers increases) influences the activation spreading within the MFM during the retrieval process.

In a number-matching task, participants had to decide whether or not a probe number matched one of two previously presented cues. In non-matching trials, the probe could be a neutral number (e.g., cues: 7 and 4, probe: 29), the product of the cues (e.g., probe: 28), a multiple of one of the cues below (e.g., probe: 24) or above the product (e.g., probe: 32).

Results showed an asymmetric interference from above and below probes. Compared to below-product probes (e.g., cues: 7 and 4, probe: 28), above-product probes (e.g., cues: 7 and 4, probe: 32) were rejected more slowly.

We interpret this asymmetric interference effect as evidence supporting the hypothesis that the retrieval process is influenced by the ANS compressed metric. We propose that within the MFM the representational overlap between a result and its adjacent neighbours is asymmetric: given a problem (e.g., *Times 4*), the representation of its result (i.e., 28) is more overlapped with its above neighbour (i.e., 32, the product of *8 times 4*) compared to the below neighbour (i.e., 24, the product of *6 times 4*). This result is discussed in relation to current models of the internal structure of the MFM.

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.. (3503) ..

**Linguistic influences on place-value processing in arithmetic fact retrieval.** JULIA BAHNMUELLER<sup>1,2</sup>, SILKE M. GÖBEL<sup>3</sup>, SILVIA PIXNER<sup>4</sup>, VERENA DRESEN<sup>4</sup> & KORBINIAN MOELLER<sup>1,2,5</sup>; <sup>1</sup>Leibniz-Institut für Wissensmedien, Tuebingen, Germany; <sup>2</sup>University of Tuebingen, Germany; <sup>3</sup>University of York, United Kingdom; <sup>4</sup>UMIT – The Health and Life Science University, Hall, Austria; <sup>5</sup>LEAD Graduate School and Research Network, University of Tuebingen, Germany

Linguistic specificities such as the inversion property of number words (e.g., in German 42 is spoken *zweiundvierzig*, literally two and forty) were shown to influence multi-digit number processing in a variety of different tasks. Thereby, cross-linguistic studies were mostly concerned with the effect of number word inversion on simple (number comparison) and calculation-based (addition) magnitude processing of numerical information. However, inversion-related effects on (multiplication) fact retrieval have hardly been addressed so far. This is particularly interesting since multiplication fact retrieval has been suggested to rely more strongly on verbal processing components than any other basic arithmetic task. To fill this gap, the present study aimed at evaluating influences of number word inversion on the processing of place-value information in multiplication fact retrieval. In a verification paradigm, we observed that the decade consistency effect (i.e., *4 times 8 = 36* vs. *4 times 8 = 28*: it is harder to reject the decade-consistent lure 36 than the decade-inconsistent one 28) was larger for English- than German-speaking participants for table-related probes. Thus, processing of the decade digits might be prioritised in English-speaking participants because the decade-digit is named first in English whereas in German the unit-digit is named first. Overall, findings of the present study generalise the observation of inversion related influences on place-value processing to arithmetic fact retrieval. By demonstrating an influence of this linguistic specificity on a numerical task as automated as the retrieval of arithmetic facts, the

present results further substantiate that place-value information is processed automatically whenever we are confronted with multi-digit numbers.

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.. (3504) ..

**Age, cross-linguistic, and modality effects on children's number line estimation.** TOM GALLAGHER-MITCHELL<sup>1</sup>, CARLOS ROMERO-RIVAS<sup>2</sup>, SARA RODRIGUEZ-CUADRADO<sup>2</sup> & TANJA DACKERMANN<sup>3</sup>; <sup>1</sup>Liverpool Hope University, United Kingdom; <sup>2</sup>Edge Hill University, United Kingdom; <sup>3</sup>Leibniz-Institut für Wissensmedien (IWM), Germany

Children's performance in the number line estimation task (estimating a target number on an empty number line with only the endpoints labelled, e.g., 0 and 100) differs across age groups, and within one age group across different number ranges (Siegler & Booth, 2004). Recent research suggests that these differences might be caused by different developmental stages in children's conceptual (e.g., number familiarity, place-value integration) and procedural knowledge (e.g., proportion-judgment strategies) (Dackermann et al., 2015). However, little is known about how task features such as presentation modality (e.g., auditory vs. visual), and cross-linguistic differences could modulate estimation processes. Interestingly, regarding this last point, some languages (e.g., German) comprise an inversion property for numbers above 20 (i.e., two-digit numbers are uttered in such a way that units precede tens). In contrast, other languages (e.g., English) do not comprise such an inversion property.

Therefore, we hypothesized that young children would have greater estimation errors than older children (Siegler & Booth, 2004), and that estimation errors would be particularly prevalent amongst young German children, because of the inversion property and their little knowledge of place-value integration.

In order to test these hypotheses, we presented German (N = 96) and British (N = 80) children (young age: 8-9 years; older age: 10-11 years) with the number line estimation task, counterbalancing two blocks in which we presented the numbers auditory or visually.

Our results showed that young German children made more estimation errors than young British children, whereas there were no differences between older German and British children. In addition, we observed that young children, in general, made more estimation errors when numbers were presented in the auditory (as compared to visual) modality.

These results suggest that number line estimation processes are modulated by cross-linguistic and presentation modality differences, although

these modulations cease during late childhood.

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.. (3505) ..

**A taxonomy of Italian abstract concepts.** CATERINA VILLANI<sup>1</sup>, LUISA LUGLI<sup>1</sup> & ANNA M. BORGHİ<sup>2,3</sup>; <sup>1</sup>University of Bologna, Italy; <sup>2</sup>Sapienza University of Rome, Italy; <sup>3</sup>Italian National Research Council, Rome

Abstract concepts can be quite diverse, spanning from numbers to mental states to social concepts. While sub-kinds of concrete concepts have been extensively investigated (e.g. artifact vs. natural objects), abstract concepts have been often considered as a whole (for exceptions Setti & Caramelli, 2005; Crutch et al., 2013; Ghio et al., 2013). One of the most important challenges identified by recent literature consists in investigating different kinds of abstract concepts and their fine-grained differences (overview in Borghi et al., 2017). The aim of our work is to provide a taxonomy of Italian abstract concepts.

Differently from previous databases, in which both concrete and abstract words were used (e.g., Barca et al., 2002; Dalla Rosa et al., 2011), we selected 425 abstract words. We classified them in subgroups: institutional, social, spatial, temporal, evaluative, linguistic, imaginary concepts, emotions (positive and negative), knowledge areas, mental states, cognitive processes, bodily states, events, physical concepts, self characteristics. A sample of 219 participants had to rate them on a 7-points scale on a variety of dimensions, including the classical abstractness, concreteness, and imagery ratings. Because of recent views that underline the importance of linguistic experience (Borghi & Binkofski, 2014; Dove, 2016) and of emotional experience (Kousta et al., 2011) for abstract concepts, we were interested in age of acquisition and modality of acquisition, to verify which subkinds of abstract concepts are acquired later and through a linguistic modality, and in valence (positive and negative). Finally, we obtained ratings on how abstract concepts evoke body-object interaction (BOI) (Siakaluk et al., 2008), and perceptual modalities (Connell & Lynott, 2012), including interoception (Dellantonio et al., 2014). Preliminary results from correlations show substantial differences between subcategories: for example, while the interoception ratings are quite high in mental states and emotional categories, they are not relevant for numerical concepts.

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.. (3506) ..

**Effects of Math Anxiety in a Number Line Estimation Task.** M. ISABEL NUÑEZ-PEÑA<sup>1,2</sup> & ANGELS COLOME GONZALEZ<sup>3,2</sup>; <sup>1</sup>*University of Barcelona -Faculty of Psychology, Section of Quantitative Psychology, Spain;* <sup>2</sup>*Institute of Neurosciences, University of Barcelona, Spain;* <sup>3</sup>*University of Barcelona -Faculty of Psychology, Section of Cognitive Processes, Spain*

**Background:** It is currently debated whether number line estimation measures the internal representation of quantities or it is a proportion judgment task requiring ability to parse the space. Poor visuo-spatial processing and a less precise quantity representation have been proposed as explanations of the lower level of mathematical performance in high math-anxious individuals (HMA). For the first time, this study compared the performance of HMA and low-math anxious individuals (LMA) in a number line estimation task.

**Method:** Twenty-four HMA and 24 LMA were presented with four lines (0-100, 0-1000, 0-100000 and 267-367) and were asked to position numbers on the line by using the mouse.

**Results:** Percentage absolute error (PAE) and linear and logarithmic coefficients of determination (R<sup>2</sup>) were calculated. Estimations of both groups were worse in the 367-line than in the other lines and HMA individuals were less accurate than LMA in both the 100000-line and the 367-line. Both groups produced estimates that were linearly related to the presented values in the 100, 1000 and 100000 lines, but the linear function fitted worse for the HMA than for the LMA group in the 100000-line. As for the 367-line, no effect reached significance.

**Discussion:** HMA performed worse than LMA in the 367 and the 100000 lines only. Given that the 367-line used magnitudes comprised in the 0-1000 range, an explanation in terms of a less precise quantity representation is discarded. Instead, it is proposed that participants perform a proportional judgment which is hindered when less familiar anchors need to be used. Task is complicated for both groups when non-standard endpoints (not ending in 0) are used. We suggest that in the case of HMA, this difficulty is greater and it extends to larger quantities, which might be less familiar to them due to their lower practice with numbers.

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.. (3507) ..

**Interactions between numerosity and mean size perception in adults with and without dyscalculia.** ELISA CASTALDI<sup>1</sup>, ANNE MIRASSOU<sup>2</sup>, STANISLAS DEHAENE<sup>1</sup>, MANUELA PIAZZA<sup>3</sup> & EVELYN EGER<sup>1</sup>; <sup>1</sup>*Cognitive Neuroimaging Unit, CEA DRF/I2BM, INSERM, Université Paris-Sud, Uni-*

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**Background.** Humans have a 'number sense', an ability to make automatic estimates of the approximate number of objects in a visual scene. However, numerical judgments can be influenced by other quantities, leading to suggestions that numerosity is not extracted independently from other features. The degree of proficiency in numerosity comparison can be predictive of current or future higher-level numerical skills. However, it has been suggested that inhibitory control might explain this relationship (i.e., the difficulty in inhibiting responses to other features varying with number in the same stimuli, such as size, area, density). This challenges the idea of a weak number sense in dyscalculia, pointing instead to a more domain general impairment.

**Methods.** In this study we generated sets of dots orthogonally varying in mean size and numerosity, to evaluate their reciprocal interference. In different sessions participants with and without dyscalculia were asked to compare sets on either their number or their mean item size, while the irrelevant dimension also varied, but could only take extreme values. Importantly, stimuli were chosen such that on average the size and number task were equated for difficulty in control subjects.

**Results.** Both groups showed a clear number interference when judging size, overestimating mean sizes when presented with higher numerosity. Control subjects showed no significant size interference when judging numerosity, suggesting that they could discard the competing size information. On the contrary, dyscalculic subjects showed strong size interference when judging number. However, they did not differ from control subjects in the degree of number interference when judging size, excluding a mere general inhibition deficit.

**Discussions.** Overall, these results suggest that at least in some circumstances number can be perceived without interference from other visual cues, however these might become more salient in case of an impaired number sense.

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.. (3508) ..

**Exploring the origin of the number-size congruency effect: Sensitivity or response bias?** DENNIS REIKE & WOLF SCHWARZ; *University of Potsdam, Germany*

Physical size modulates the efficiency of digit comparison, depending on whether the relation of numerical magnitude and physical size is congruent or incongruent (Besner & Coltheart, 1979), the

number-size congruency effect (NSCE). In addition, Henik and Tzelgov (1982) first reported an NSCE for the reverse task of comparing the physical size of digits such that the numerical magnitude of digits modulated the time required to compare their physical sizes. Does the NSCE in physical comparisons simply reflect a number-mediated bias mechanism related to making decisions and selecting responses about the digit's sizes? Alternatively, or in addition, the NSCE might indicate a true increase in the ability to discriminate small and large font sizes when these sizes are congruent with the digit's symbolic numerical meaning, over and above response bias effects. We present a new research design that permits us to apply signal detection theory to a task that required observers to judge the physical size of digits. Our results clearly demonstrate that the NSCE cannot be reduced to mere response bias effects, and that genuine sensitivity gains for congruent number-size pairings contribute to the NSCE.

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### Poster Session III S16, Tuesday, 10:40 – 12:00

.. (3601) ..

**Spatial Compatibility When Adopting an Avatar's View.** JOCHEN MÜSSELER & CHRISTIAN BÖFFEL; *RWTH Aachen University, Germany*

If an actor takes the allocentric perspective of an avatar, spatial dissociations could arise between the perspective of the actor and the perspective of the avatar. A modification of the spatial compatibility relationships is predicted to the extent with which the actor identifies herself/himself with the avatar. The present experiments gather objective performance measures and aim at identifying the conditions in which an actor adopts the avatar's view. The results support the idea of the predicted change of perspective and indicate an integration of the avatar's view into the actor's self-representation.

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.. (3602) ..

**Influence of automatic intervention on manipulation consequence evaluation during tool use.** SAYAKO UEDA<sup>1</sup>, RYOICHI NAKASHIMA<sup>2</sup> & TAKATSUNE KUMADA<sup>1,3</sup>; <sup>1</sup>RIKEN BSI-TOYOTA Collaboration Center, RIKEN, Wako, Japan; <sup>2</sup>The Department of Psychology, The University of Tokyo, Tokyo, Japan; <sup>3</sup>Graduate School of Informatics, Kyoto University, Kyoto, Japan

When using a tool, manipulators can evaluate the consequence of their manipulation, at least, in two aspects, the sense of agency (SOA), i.e., the experience of controlling one's own actions, and their performance. Basically, SOA evaluation and performance evaluation should rely on different mechanisms. However, previous studies on SOA showed that manipulators' SOA increases with performance in assisted conditions relative to self-control conditions (i.e. the manipulators experienced illusory SOA), suggesting the interaction between performance evaluation mechanism and SOA evaluation mechanism. In this study, we hypothesized that the interaction is not consistent across any levels of intervention. More specifically, we predicted that illusory positive SOA would decrease in highly assisted conditions. Using a visuomotor tracking task, the level of intervention was varied across conditions, from the self-control condition as a control to the 100 % assisted condition, in which participants' manipulation was perfectly corrected. Participants were not informed about the intervention and asked to evaluate their manipulation consequence concerning their performance and their SOA in the end of each trial. As a result, we replicated a previous finding: Both performance evaluation and SOA evaluation increased with the degree of intervention (participants' SOA evaluation increased with performance evaluation as well performance in itself). However, in the 100 % assisted condition, although some participants still reported SOA, SOA evaluation significantly decreased relative to the 0 % assist condition, but performance evaluation did not. In other words, in the fully assisted condition, SOA evaluation was collapsed even when the performance was completely consistent with manipulators' intention. This study showed first evidence that SOA does not completely depend on performance evaluation in assisted conditions. SOA evaluation mechanism interacts with performance evaluation mechanism within a certain level of assistance, but turns to be independent from it if assistance exceeds the level.

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.. (3603) ..

**Task-irrelevant object response increases the subjective sense of control for the automatic control object.** RYOICHI NAKASHIMA<sup>1,2</sup> & TAKATSUNE KUMADA<sup>2,3</sup>; <sup>1</sup>The University of Tokyo, Japan; <sup>2</sup>RIKEN, Japan; <sup>3</sup>Kyoto University, Japan

The sense of control, which refers the feeling that I am the agent for controlling the object, is important to learn and enjoy the manipulation. In contrast, recent automatic control systems require the operators less manual control, leading decrease of operator's sense of control. This study investigated



the way to increase the sense of control for the automatic control situation. Specifically, we focused on the effect of the task-irrelevant object response to operators' action on their subjective sense of control.

Participants asked to brake a moving black circle by keypress to stop the circle near a goal area. When the key was pressed, the circle slowed down and stopped. Then participants estimated their subjective sense of control for stopping the circle. Participants were informed that there were some trials in which the circle stopped independently of their keypress (i.e., automatic control trials). Actually, 86% of the trials were the automatic control trials, and the remaining trials were the manual control trials where the circle stopped by their keypress. In a half of the automatic control trials, the color of the circle changed to white briefly at the moment of their keypress (i.e., task-irrelevant object flash).

The subjective sense of control was higher when the circle flashed than when the circle did not flash. Results of additional experiments showed that the effect did not occur when circle flashed independently of the keypress, and that the effect did not occur in the manual control trials, which we did not attribute to the ceiling effect. Therefore, the proper timing object response to the operators' action, even if it is irrelevant to the control, can increase the subjective sense of control for the object controlled automatically.

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.. (3604) ..

**The influence of task complexity on the transfer of training.** NATALIA ANDRIYANOVA; *St-Peterburg State University, Russian Federation*

Different studies focus on the possibility to transfer of training between different types of tasks (Coelho, Nusbaum, Rosenbaum, Fenn, 2012; Takeuchi, Kawashima, 2012; Jaeggi et al., 2013).

In our study we investigate the transfer of training from perceptual to sensorimotor tasks. Our experiment included one control and one experimental group. Firstly participants from both groups took part in the testing task. Red, yellow and green circles appeared on the different parts of the computer screen. The task was to push "space" when green circle appeared. The testing task was finished after 10 correct answers. The training task was one day after the testing task. Participants from the experimental group should estimate which line from the cross was longer. The crosses were presented for 250 ms. After three correct answers in a row the time reduced by 20 ms. Minimal presentation time was 30 ms. Control group did the same task, but without the reduction of time (30 trials for 250 ms.). Immediately after the training task both

groups took part in the testing task. Participants repeated this procedure in the following four days. Thus, they did six sessions of testing task and five sessions of training task.

The results showed that participants from the experimental group performed testing task after first training task faster than before training task. In the control group the response time in the testing task didn't decrease after first training task. In this group significant reduction of response time were found only on the sixth testing task, but it was still higher than in the experimental group. Thus, the perceptual task performance with the reduction of the presentation time facilitates the speed-up of sensorimotor task performance better than the perceptual task performance at constant speed.

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.. (3605) ..

**Small is left and big is right: Compatibility between physical stimulus size and left-right responses.** PETER WÜHR<sup>1</sup> & CHRISTIAN SEEGLKE<sup>2</sup>; <sup>1</sup>TU Dortmund University, Germany; <sup>2</sup>Bielefeld University, Germany

Previous research has extensively studied the relationship between the cognitive representations of space and magnitude. A prominent example is the SNARC effect, which describes the finding that mapping small numbers to left responses and large numbers to right responses reveals better performance than the opposite mapping. Similar effects of stimulus-response compatibility were observed between the conceptual size of stimuli and spatial response location. These, and other findings, have led to the idea that quantity, time, and space share a general magnitude code, as expressed in A Theory Of Magnitude (ATOM; Walsh, 2003). Interestingly though, research has largely ignored the relationship between physical (stimulus) size and spatial (response) location, although one might expect similar compatibility effects as between conceptual size and response location. We conducted two experiments investigating compatibility effects between physical stimulus size and left-right responses. In both experiments a small square and a big square (presented at screen center) served as stimuli, and the right-handed participants responded by pressing a left or a right key. In Experiment 1, size was the relevant stimulus feature and we varied the stimulus-response mapping within participants. The results of Experiment 1 revealed a strong compatibility effect: Performance was better with the compatible mapping (small-left vs. big-right) than with the incompatible mapping (big-left vs. small-right). In Experiment 2, participants responded to stimulus color, which varied independ-

ently of stimulus size, by pressing a left or right key. Results showed a congruency effect that mirrored the compatibility effect of Experiment 1: Performance was better in compatible trials than in incompatible trials. The results of our experiments suggest a strong relationship between the cognitive representation of physical (stimulus) size and response location in right-handers. The findings support the notion of a general magnitude code, as proposed in ATOM (Walsh, 2003).

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.. (3606) ..

**Working Memory demands modulate task-order coordination processes in dual-task situations.** SEBASTIAN KÜBLER<sup>1,2</sup>, TILO STROBACH<sup>3</sup> & TORSTEN SCHUBERT<sup>1,2</sup>; <sup>1</sup>Martin-Luther-Universität Halle-Wittenberg, Germany; <sup>2</sup>Humboldt Universität zu Berlin, Germany; <sup>3</sup>MSH Medical School Hamburg, Germany

Dual-task (DT) situations are characterized by the requirement for additional task-order coordination processes that are crucial for regulating the processing order of two temporally overlapping tasks. These task-order coordination processes can be investigated when participants perform DT blocks with a variable order of both component tasks. Performance is usually improved on a trial N when both tasks are processed in the same order relative to the preceding trial N-1 (same-order trial) compared to when the processing order of both tasks differs relative to the previous trial (different-order trial). In two experiments, we tested the hypothesis that this performance benefit for same-order trials results from task-order priming based on an order trace of the previous trial that is stored in Working Memory (WM). For this purpose, participants performed a DT consisting of two choice reaction tasks in random-order DT blocks. Demands on WM were manipulated by increasing the number of stimulus-response bindings (Experiment 1) or implementing an additional updating task into the experimental paradigm (Experiment 2). As a result, we found that the performance benefit for same-order trials was reduced when demands on WM were increased. This result is in line with the assumption that the scheduling of two tasks in DT situations can be prepared based on prior task experience. More specifically, we argue that the processing order of the two tasks on a given DT is primed based on order-information from the previous trial which is stored in WM.

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.. (3607) ..

**Reward Differentially Modulates Approach and Avoidance Responses to Emotional Stimuli.** ONUR ASCI, LUC VERMEYLEN & RUTH M. KREBS;

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Studies from multiple research domains demonstrated that emotion and reward signals share commonalities in the way they shape approach-avoidance tendencies. However, these findings stem from experiments where emotion and reward stimuli are presented separately and the emotion information is (most often) task-irrelevant. In the current study, we conducted two experiments to investigate how task-relevant emotional information and reward directly interact when they are presented simultaneously. In study 1 (N=28), a positive or negative emotional picture was presented simultaneously with a manikin in a Go/NoGo task. Participants moved a manikin towards the positive pictures (approach) and away from the negative pictures (avoid) via a joystick. Monetary reward prospect was indicated by the color of the manikin (and the Go/NoGo information was indicated by its shape). Overall, the prospect of reward signals led to faster responses. Furthermore, we observed an interaction between emotion and reward in the accuracy data due to a reversed pattern in reward versus no reward trials, with fewer errors were made in reward trials that featured positive stimuli and fewer errors were made in no reward trials featuring negative stimuli. In study 2 (Go trials only), we signaled reward by coloring the fixation point in the center of the emotional stimulus (to avoid attentional shifts), included neutral stimulus trials in which a third joystick movement led to a rotation of the manikin without changing the distance to the picture (neither approach nor avoidance), and controlled for movement direction by counterbalancing picture location. Preliminary results (N=16) show an interaction between emotion and reward driven by faster responses in reward trials with positive stimuli, and a replication of the accuracy pattern of study 1 with a reversed reward effect for positive versus negative stimuli. Taken together, these results suggest that concurrent reward signals further emphasize natural response tendencies to emotional stimuli.

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**Temporally Dissociable Signatures of Functional Plasticity after Task-Shifting Training in Older Adults.** SANDRA DÖRRENBÄCHER, JUTTA KRAY & HUBERT ZIMMER; Saarland University, Germany

Cognitive control is subserved by a dynamic interplay of phasic and tonic brain activation across fronto-parietal networks. Older adults show large disturbances in this dynamic functional recruitment of cortical brain activation. At the same time, recent research on cognitive training suggests that specific practice in task shifting may enable older adults to redistribute their brain activ-

ation by up- or down-regulating functional activation across cortical networks, thus in turn leads to improvements in task performance. However, such findings in older adults are scarce and previous studies focused only on anatomical but not on temporal redistribution effects, such as by dissociating phasic and tonic timescales of activation. In the present study, we wanted to analyze training-related functional redistribution of task activation within fronto-parietal circuits in old age by applying functional magnetic resonance imaging (fMRI) techniques that are sensitive to track the timescale of brain activation, and to analyze these effects as a function of inter-individual differences in baseline performance, as it is assumed that neural redistribution in age may largely depend on an individual's initial potentials. Fifty older adults were assigned to a task-shifting training and an active-control group and their pretest/posttest brain-change maps were compared against 25 untrained younger controls. Results revealed that a task-shifting training in older adults promoted (i) higher reliance on phasic activation in circuits supporting flexible shifting (such as the inferior frontal junction and the superior parietal lobule), which was related to larger performance gains; (ii) reduced tonic responses in circuits underpinning stable maintenance (such as the anterior prefrontal cortex and the inferior frontal gyrus), perhaps to set resources free for a stronger phasic modulation; and (iii) greater changes in low-performing elders that had more room for improvement.

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**The specificity and consistency of responses patterns in the right inferior frontal sulcus during the implementation of novel task instructions.** NICOLAS BOURGUIGNON, SENNE BRAEM, JAN DE HOUWER & MARCEL BRASS; *Ghent University, Belgium*

Verbal instructions are central to humans' capacity to learn new behaviors with minimal practice, but the neurocognitive mechanisms involved in verbally instructed behaviors remain puzzling. Recent functional magnetic resonance imaging (fMRI) evidence suggests that the right (middle) inferior frontal sulcus (rIFS) supports the translation of symbolic stimulus-response associations into sensorimotor representations. Here, we set out to (1) replicate this finding, (2) investigate whether this region's involvement is specific to novel (versus trained) instructions, and (3) study whether the rIFS also shows differences in its (voxel) pattern response. Participants were shown instructions which they either had to perform later (i.e., "implement") or merely recall (i.e., "memorize"), which were either entirely novel or had been trained

prior to the fMRI session. Results replicate the higher rIFS activation levels during instruction implementation versus memorization, and show how this difference is restricted to novel, but not trained, instruction presentations. Pattern similarity analyses at the voxel level further reveal a more consistent neural pattern response in the rIFS during the implementation of novel versus trained instructions (but not during the memorization of instructions). In fact, this more consistent neural pattern response seemed to be specific to the first instruction presentation, and disappeared after the instruction had been applied once. These results further support the specific role of the rIFS in the implementation of novel task instructions, and highlight potentially important differences in studying this region's gross activation levels versus (the consistency of) its response pattern.

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**The effects of performance contingent and non-contingent feedback on the speed-accuracy trade-off.** ANNE CHARLOTTE TRUTTI<sup>1,2</sup>, ZSUZSIKA SJOERDS<sup>1</sup>, BIRTE FORSTMANN<sup>2,3</sup> & BERNAHRD HOMMEL<sup>1</sup>; <sup>1</sup>*Leiden University, the Netherlands, Netherlands, The*; <sup>2</sup>*University of Amsterdam, Integrative Model-based Cognitive Neuroscience Research Unit Group, Amsterdam, The Netherlands*; <sup>3</sup>*Netherlands Institute for Neuroscience, an Institute of the Royal Netherlands Academy of Arts and Sciences, Amsterdam, the Netherlands*

A recent study by Hefer & Dreisbach (2017) highlighted the differential effects of performance contingent and performance non-contingent feedback/reward on goal stability and flexibility. Inspired by these findings, the effects of contingent vs non-contingent feedback were tested in a random dots motion paradigm, a paradigm that has been studied extensively in the past years with respect to the speed-accuracy tradeoff. Application of sequential sampling models to the response time distributions further allows for inference of certain cognitive processes that are associated with the feedback manipulation, such as the response threshold representing caution or urgency.

In a between subject design, one group ("P") received performance contingent feedback on the accuracy (or speed) of the previous trial in the random dots motion task, while the other group ("F") randomly receives performance non-contingent feedback ("Well done!"). Speed vs accuracy emphasis was presented previous to each trial. The experiment consists of four trial blocks, with randomized vs blocked order of speed vs. accuracy trials.

Results show that group P outperforms group F in blocked trials, while group F outperforms group

P in randomised trials. Additionally, application of the drift diffusion model shows that group F exhibits a more dynamic response threshold parameter compared to group P.

Findings support findings by Hefer & Dreisbach (2017) by translating them to a new experimental paradigm. Further, a dynamic threshold parameter is associated with striatal activation (van Maanen et al. 2016; Ho et al. 2012), hence our findings support the theory behind cognitive stability - flexibility research of the recent years (Dreisbach & Goschke, 2004; Cools & D'Esposito, 2011).

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**Natural vs. Urban environments: an electrophysiological approach to the attention restoration theory (ART)** SIMONE GRASSINI<sup>1,2</sup>, HENRY RAILO<sup>1,2</sup>, SERENA CASTELLOTTI<sup>1,3</sup>, IRENE PETRIZZO<sup>1,3</sup>, ANTTI REVONSUO<sup>1,2,4</sup> & MIKA KOIVISTO<sup>1,2</sup>; <sup>1</sup>University of Turku, Finland; <sup>2</sup>Centre for Cognitive Neuroscience, Turku, Finland; <sup>3</sup>University of Florence, Italy; <sup>4</sup>University of Skövde, Sweden

Growing trend for urbanization worldwide and the progressive distancing of the majority of world's population from natural environments claim for investigations about the importance of human contact with nature, to preserve and improve mental and physical health.

The restorative effects of natural environments have been generally explained from an evolutionary perspective. The common argument underlines that, as an outcome of millions of years of evolution in natural environments, human beings have developed a genetic readiness to interact with natural environments (Kellert & Wilson, 1993; Grinde 2009 and Grinde & Patil 2009). Kaplan & Kaplan (1989) refer to this quality of natural setting as "soft fascination" and attribute to this characteristic an important role in giving to natural environments restorative features (ART, Attention Restoration Theory). In our research project, we aim to investigate the biological markers of the restorative effects of Natural environments. In the present experiment, we used Electroencephalography (EEG), to record brain activity. Hundreds of images of natural and urban environments were presented to the participants, and EEG responses were recorded. At random intervals, participants were asked to rate how restorative they found the last image that was presented to them. The EEG results showed that, in line with ART, urban images capture attention more than natural images. Furthermore, participants subjectively rated natural images also as more restorative compared to non-natural ones. In our poster, we shall present preliminary electrophysiological and behavioral data.

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**The effects of incongruent emotion expectation on affective picture processing: An event-related potential (ERP) study.** ANN-KATHRIN JOHNEN & NEIL HARRISON; *Liverpool Hope University, United Kingdom*

Recent studies have shown that uncertainty about the expected valence of an upcoming stimulus modulates neural responses to that stimulus. However, little is known about how incongruent emotion expectation (e.g. expecting a positive picture but seeing a negative picture) affects neural and behavioural responses to a subsequent picture. To investigate this, participants were asked to view and rate the pleasantness of emotional pictures that were preceded by a cue while neural responses were measured using electroencephalography (EEG). In the congruent condition (70% of trials) the cue correctly indicated the valence of the upcoming picture. The remaining 30% of trials were incongruent, where the cue indicated a different valence compared to the actual valence of the upcoming picture. Behavioural results showed that incongruently cued pictures were associated with more neutral valence ratings (i.e. incongruently cued negative pictures were associated with higher valence ratings compared to congruently cued negative pictures). Event-related potential (ERP) results showed an increased Late Positive Potential (LPP) response, maximal at 520ms, in response to the congruent negative compared to the incongruent negative pictures. For positive pictures, the LPP difference was not significant. Previous research has suggested that the increased LPP response to congruently cued negative pictures is due to increased motivated attention. However, this explanation might not be well-suited to explain the current results and alternative explanations such as emotion regulation should be considered. The present results are discussed in relation to attentional and emotion regulation mechanisms and future directions for research on emotion expectation are outlined.

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**Multimodal Neuroimaging of Cognitive Load in a Combined Negative Priming and Stroop Task.** ERWIN LEMCHE; *Institute of Psychiatry, Psychology and Neuroscience, United Kingdom*

Previous studies have yielded evidence for cognitive processing abnormalities and alterations of autonomic functioning in depersonalization-

derealization disorder (DPDR). However, multimodal neuroimaging and psychophysiology studies have not yet been conducted

to test for functional and effective connectivity under cognitive stress in patients with DPDR.

DPRD and non-referred control subjects

underwent a combined Stroop/negative priming task, and the neural correlates of Stroop interference effect, negative priming effect,

error rates, cognitive load span and average amplitude of skin conductance responses were ascertained for both groups. Evoked

haemodynamic responses for basic Stroop/negative priming activations were compared. For basic Stroop to neutral contrast, patients

with DPRD differed in the location (inferior vs. superior lobule) of the parietal region involved, but showed similar activations in the left

frontal region. In addition, patients with DPRD also co-activated the dorsomedial prefrontal cortex (BA9) and posterior cingulate cortex

(BA31), which were also found to be the main between-group difference regions. These regions furthermore showed connectivity with

frequency of depersonalization states. Evoked haemodynamic responses drawn from regions of interest indicated significant between-group

differences in 30–40% of time points. Brain-behaviour correlations differed mainly in laterality, yet only slightly in regions. A

reversal of autonomic patterning became evident in patients with DPRD for cognitive load spans, indicating less effective arousal

suppression under cognitive stress – patients with DPRD showed positive associations of cognitive load with autonomic responses,

whereas controls exhibit respective inverse association. Overall, the results of the present study show only minor executive cognitive

peculiarities, but further support the notion of abnormalities in autonomic functioning in patients with DPRD.

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**Influence of transcranial direct current stimulation (tDCS) applied over the dorsolateral prefrontal cortex on dual-task performance in young and old adults.** FLORENCE GAILLARDIN & STÉPHANE BAUDRY; *Laboratory of Applied Biology and Neurophysiology, Université libre de Bruxelles, Belgium*

**Introduction** Transcranial direct current stimulation (tDCS), a non-invasive brain stimulation technique, can enhance cognitive functions in healthy older adults (1), but its effects on the performance of dual-task involving postural and cognitive challenging tasks remains poorly investigated (2). The purpose of the present study was to investigate the effects of anodal tDCS (the anode is placed over the area of interest, a-tDCS) applied over the left dorsolateral prefrontal cortex (DLPFC) on cogni-

tive and motor performances during dual-task situations in young and older adults.

**Methods** Fifteen young and fifteen old adults participated in two experimental sessions. Before and after a-tDCS (20 min) and sham stimulation (90s) of the left DLPFC, subjects performed a Go-NoGo task (3) while standing on a force platform, in three dual-task conditions: 1/ easy Go-NoGo, easy balance task (feet hip-width apart, EE); 2/ complex Go-NoGo, easy balance task (CE); 3/ complex Go-NoGo, complex balance task (feet joined, CC). Performances in cognitive task (correct responses of Go and NoGo stimuli, conflict and irrelevant errors, reaction time to Go stimuli) and postural task (path length, medio-lateral and antero-posterior fluctuations of the center of pressure) were measured.

**Results** In CE and CC conditions, percentage of conflict errors decreased (-5.28% and -6.39%,  $p < 0.05$ ) while reaction time decreased only in CC (-5.83%,  $p = 0.008$ ) after a-tDCS in older adults. No change was observed on postural performances in older adults, and no postural or cognitive effect was observed in young subjects after a-tDCS. No significant changes were observed after sham stimulation, regardless of age and dual-task conditions.

**Discussion** The results indicate that a-tDCS of DLPFC increases cognitive performances in a complex dual-task in older adults, particularly when the cognitive task involves executive functioning. This result has clinical and scientific relevance to better understand the influence of ageing on cognitive processing.

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## Poster Session III S17, Tuesday, 10:40 – 12:00

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**Social Inhibition of Return: How social is it?** ORIT NAFCHA<sup>1,2</sup>, SIMONE SHAMAY-TSOORY<sup>1</sup> & SHAI GABAY<sup>1,2</sup>; <sup>1</sup>University of Haifa, Israel; <sup>2</sup>Institute of Information Processing and Decision Making (IIPDM)

Understanding others' actions and intentions, is important in order to successfully act in the environment. It was suggested that when we are observing another person action toward a specific location, an inhibitory process is initiated at that location. This effect was termed Social Inhibition of Return (SIOR; Welsh et al., 2005). In a series of studies we examined this effect by developing a dyadic computerized task in which each participant, in his turn, respond to a peripherally presented target in two successive trials. The first trial is preformed after the other participant response and is aimed

to examine SIOR. The second trial for each participant is aimed to study the self-induced IOR. Participants did not see the other participant's action, only received information regarding the location to which s/he reacts on. Results depicted that participants were slower to react to targets appearing in the same location as the previous target, regardless if they or their counterpart responded to it. Importantly, when participants preformed the same task, with the same visual display, only without a counterpart, the SIOR was abolished. These findings suggest that the perceived social aspects, but not the visual aspects of the task, are crucial for eliciting SIOR.

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**Beyond recognition: Examining the effect of selective attention on encoding in free recall.** HANAE DAVIS & BRUCE MILLIKEN; *McMaster University, Canada*

The effect of selective attention on encoding has been the focus of two recent studies (Krebs, Boehler, De Belder & Egner, 2015; Rosner, D'Angelo, MacLellan & Milliken, 2015). Both studies examined how selective attention demands at encoding affect later remembering, and found superior recognition memory for trials on which selective attention demands were high (incongruent trials) compared to trials on which they were low (congruent trials). Follow-up studies in our lab have examined the boundary conditions of this effect, and have found it to be robust in recognition memory. No research to date has examined this effect in free recall, an important issue to address as recognition and recall are thought to tap different underlying memory processes (Kintsch 1970; McDaniel & Bugg, 2008). To better understand how selective attention demands at encoding affect long term memory—and not just recognition memory—we examined their effects in free recall. Across two experiments, participants completed four study-test blocks. At study, red and green spatially interleaved words were presented on each trial, and the two words were either the same (congruent trials) or different (incongruent trials). At test, participants completed a recognition task in Experiment 1 and a free recall task in Experiment 2. Memory performance was better for incongruent than congruent trials in both recognition—replicating the original effect—and, importantly, in free recall. We also observed differences in the pattern of performance across the two memory tasks, which may shed light on the cognitive processes that underlie this effect. The results are discussed in the context of the item-specific versus relational processing distinction from the memory literature (Hunt & Einstein, 1981).

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**Prospective memory and APOE genotype in the early stages of memory decline.** CLAIRE LANCASTER<sup>1</sup>, NAJI TABET<sup>2</sup> & JENNIFER RUSTED<sup>1</sup>; <sup>1</sup>*University of Sussex, United Kingdom*; <sup>2</sup>*Brighton and Sussex Medical School, United Kingdom*

**Background:** Successful prospective memory (PM) is driven by two dynamic processes; effortful attention control and cue-driven spontaneous retrieval. This research explores if older adults with subjective memory impairment (SMI) or mild cognitive impairment (MCI), who differ by APOE genotype (and therefore, by late-life dementia risk), show deficits in PM performance and the strategies used to support retrieval.

**Methods:** Forty-eight memory service patients (35 MCI, 13 SMI) and 52 controls (overall mean age: 73.7 years), differentiated by APOE genotype, completed a computerised measure of PM. Frequency of PM targets was varied across blocks to manipulate PM retrieval expectancy. Accuracy of PM target detection and cost to ongoing task performance was measured

**Results:** Accuracy of PM target detection was equivalent in individuals diagnosed with MCI or SMI, and the control group. APOE genotype did not differentiate PM target detection in the memory service group, however, APOE-e4 carriers in the control group were less accurate in retrieving initial PM targets. Cost to ongoing task performance was not significantly different in the memory service group compared to the healthy control group. In addition, no APOE genotype differences were reported in ongoing task cost for either the memory service or control group. Reduced frequency of PM targets was associated with decreased ongoing task cost, but there was no group (MCI/SMI vs. control) or genotype differences in the pattern of change observed.

**Discussion:** The attentional control processes required for prospecting remembering are maintained in the early stages of memory decline. Non-significant APOE genotype differences in the memory service group may reflect an early self-referral process that identifies an emerging clinical population, independent of APOE status. Consistent with the association between APOE e4 and poorer cognition in older age, disadvantaged performance in 'healthy' e4 carriers imply a greater attentional resource is needed to maintain performance.

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**Untangling the Interactions of the Attention System.** NAAMA KATZIN<sup>1</sup>, OMER LINKOVSKI<sup>2</sup>, NOAM WEINBACH<sup>2</sup> & AVISHAI HENIK<sup>1</sup>; <sup>1</sup>*Ben-Gurion University of the Negev, Israel*; <sup>2</sup>*Department of Psychiatry and Behavioral Sciences, Stanford University*

In the beginning of the 90's Posner and colleagues suggested that the attention system is composed of three sub-systems: the alerting system, the orienting system and executive functions. They hypothesized that these systems are independent and do not interact. Following this theory, the Attentional Networks Test-Interactions (ANT-I) task was designed. Typical results of the ANT-I show that these systems interact with each other and they are not independent. In this study we show that the interactions between executive functions and alertness, and executive functions and orienting exist because the spatial dimension of the flanker stimuli. To this end, in a series of experiments we replaced the flanker stimuli with Stroop like stimuli. Our results suggest that the three attention networks interactions depend on task demands.

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**Mental Manipulation and Goal-Directed Behavior.** MORAN BAR-HEN-SCHWEIGER & AVISHAI HENIK; *Ben-Gurion University of the Negev, Israel*

Mental manipulation (MM) involves mental evaluations and transformations of various aspects of entities, where some of these processes involve operating on a perceived object, while others reflect integration and manipulation of non-objects, such as ideas. MM is presumed to be domain-general in that it involves a wide variety of mental activities and can be assessed by different measures varying in their content. Therefore, we propose that MM is important to cognitive control and goal-directed behavior.

The current study was designed to explore the relationship between MM and various aspects of goal-directed behavior, using the methodology of Structural Equation Modeling (SEM). This method enables examining the relationship among various MM constructs and goal-directed behavior.

In order to examine the relationship between MM and measures of cognitive control, 190 participants completed a variety of tasks assumed to represent the basic components of MM and cognitive control (e.g., working memory and inhibition tests). SEM was utilized to examine first- and second-order models. The analyses produced favorable evidence supporting MM as a differentiated construct, yet indicated some degree of shared, underlying cognitive processes of MM and components of cognitive control.

The pattern of correlations among MM and cog-

nitive control factors seems to be in line with our suggestion that cognitive control and MM share some cognitive processes but also involve distinct operations.

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**Reward- and loss-related target features improve performance in the Stroop task.** THOMAS CARSTEN, VINCENT HOOFS, C. NICO BOEHLER & RUTH M. KREBS; *Ghent University, Belgium*

Background: Previous studies have shown that cued reward prospect promotes efficient responding to task-relevant information while avoiding distraction. Remarkably, this cognitive control process can be enhanced even when the signal for potential reward is linked to the target stimulus itself, suggesting that cognitive control can be mobilized in a rapid, rather 'reactive' fashion. However, to our knowledge no study has tested whether the outlook to avoid potential losses can recruit fast control processes in a similar way. On the one hand, the negative affective value associated with potential losses might delay the recruitment of control processes. On the other, there is evidence that loss avoidance can prove equally (or even more) effective as reward prospect to facilitate performance. Method: In three subsequent studies we introduced target colors predicting wins, losses, or neutral outcomes dependent on performance in a Stroop task. Results: In line with the notion that negative signals may discourage effective responding, responses to loss-related targets were slower compared to win-related targets, while both types of incentives improved performance in contrast to neutral trials (study 1). In two follow-up studies, we investigated whether the proportion of comparatively favorable outcomes may account for these findings. After matching the amount of objectively favorable outcomes between conditions, win and loss incentives improved performance to a similar degree. Discussion: Taken together, our data suggests that not the affective value of the outcome per se, but the proportion of favorable consequences drives performance improvement in this type of cognitive control tasks.

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**Level-specific attentional adjustment to proportion congruency in the processing of hierarchical stimuli.** MIRIAM TOMAT<sup>1</sup>, MIKE WENDT<sup>2</sup> & THOMAS JACOBSEN<sup>1</sup>; <sup>1</sup>*Helmut Schmidt University/University of the Federal Armed Forces Hamburg, Germany*; <sup>2</sup>*Medical School Hamburg*

Congruency effects in conflict tasks (such as Stroop or Eriksen Flanker) tend to be larger when

the ratio of congruent and incongruent trials (i.e., proportion congruency, PC) is increased. This PC effect has been attributed to attentional adjustment, that is, increased focusing of attention on target stimulus information when the PC is low. We investigated attentional adjustment to PC in the processing of global and local stimulus information. Participants frequently switched between identifying the global and the local level of hierarchical (Navon) stimuli while the PC varied between 75% and 25% in different blocks of trials. To control for stimulus-specific practice and strategic usage of specific distractor-response contingencies, we divided the stimuli into one set which was used to manipulate the PC (i.e., induction stimuli) and another set whose elements were presented with constant frequency in both PC conditions (preventing PC-related differences in stimulus-specific practice and in distractor-response contingency). In Experiment 1, the PC was manipulated in opposing ways for the two target levels (i.e., high for one and low for the other in a given block of trials). Level-specific PC effects (i.e., a larger congruency effect when the PC was high regarding the target level of the current trial) occurred for both the induction stimuli and the test stimuli, suggesting that attention was shifted towards the level associated with the lower PC. In Experiment 2, PC effects occurred for the induction stimuli but very little for the test stimuli. This result suggests that presenting a low PC on both target levels in the same block of trials strongly reduced attentional adjustment and that lack of control of stimulus-specific practice or of distractor-response contingency may yield results mimicking effects of attentional adjustment to PC.

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**Confirmation of the age-related increase in cross-modal deviance distraction using a relative measure of deviance distraction.** FABRICE PARMENTIER, ALICIA LEIVA & PILAR ANDRES; *University of the Balearic Islands, Spain*

Unexpected changes in a train of otherwise repeated task-irrelevant sounds (deviant among standard sounds) capture attention and lengthen response times to visual targets (cross-modal deviance distraction). Several studies showed that this effect (defined as the absolute difference between response times in deviant and standard trials) increases in old age. Here we examine whether this increase may be due to general slowing. To do so we used a relative measure of deviance distraction (proportional increase in response time in the deviant condition relative to the standard) to re-analyze the data of 204 participants (108 young and 96 older adults) from four published studies. The results showed a significant effect of aging on relative de-

viance distraction, thereby ruling out general slowing as a credible account of the effect. The analysis of absolute and relative deviance distraction using delta plots further confirmed this conclusion but also showed some evidence, in older adults, of the additional contribution of mechanisms sensitive to general slowing visible in late responses.

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**The capture of event encoding by irrelevant distractors: Toward a common account of negative priming and inhibition of return.** LISA LORENTZ, MARIA C. D'ANGELO, MITCHELL R.P. LAPOINTE & BRUCE MILLIKEN; *McMaster University, Canada*

Negative priming (NP) and inhibition of return (IOR) are two well-established trial-to-trial effects used to study inhibitory attentional mechanisms. Importantly, however, researchers have suggested that these two effects are caused by disparate inhibitory mechanisms (but see Houghton & Tipper, 1994; Milliken, Tipper, Houghton & Lupianez, 2000). This thinking is driven largely by the fact that the methods required to measure NP and IOR appear to be fundamentally different. In the present study, we examined the idea that surface differences in methods used to measure NP and IOR may actually influence the same underlying processes. If supported, this would suggest that NP and IOR reflect two different tasks that allow for exploration of the same suite of cognitive processes. To explore this idea, we focused on two methodological issues in particular: (1) selective attention at the time of the probe in studies of NP; and (2) central cue methods that pull attention away from the peripherally cued location in studies of IOR. Using a simple prime-target word-naming task, the temporal onset of a distractor item was manipulated such that it appeared either simultaneously with the target to impose a selective attention demand, or appeared temporally between prime and target, as would occur in a "cue-back" IOR procedure. Crucially, response times were slower for repeated than for not-repeated targets in both conditions. We interpret these results to imply that both probe distractors and events that intervene between prime and target influence the same cognitive process—a process that disrupts integration between similar prime-target pairs. A manipulation of distractor luminance further supported this conclusion. The results of these experiments support the view that both NP and IOR reflect a fundamental event encoding advantage for targets that are dissimilar to preceding primes.

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**Attentional selection of fearful faces: stimulus-driven capture or contingent capture?** QUENTIN VICTEUR, PASCAL HUGUET & LAETITIA SILVERT; *Université Clermont Auvergne, CNRS, LAPSCO, F-63000 Clermont-Ferrand, France*

It is generally assumed that faces, especially those expressing negative emotions, benefit from a privileged status in the attentional selection process. However, the nature of this selection remains unclear. Expressive faces may automatically capture attention, in the same way as visually salient information (the “stimulus-driven” hypothesis), but their selection could also be modulated by their relevance according to the current goals of the observer (the “contingent capture” hypothesis). We tested these two hypotheses using the spatial cueing paradigm. In three experiments, we systematically modulated the task-relevance of photographs of neutral and fearful faces displayed as cues by modifying the task to perform on schematic target faces and non-faces: the participants had to look either for a particular color, for a face, or for a particular expression. We showed that regardless of their expression, the faces presented in the cue display did not capture attention when they were not contingent with the observer’s objectives (in the color task), but did when the facial dimension was made contingent (in the face task). Finally, we observed a difference between neutral and fearful faces in their capacity to capture attention only when it was the emotional dimension that was made contingent (in the facial expression task). Our results demonstrate that the capacity of emotional faces to capture attention is not automatic, and is actually dependent on the observer’s goals. More generally, our experiments suggest that emotional expressions can impact the attentional selection process only when emotion is directly relevant for the observer’s objectives.

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**Examining the Hierarchy of Attention- and Task-Switches in an Auditory Attention-Switching Paradigm.** JULIA C. SEIBOLD, SOPHIE A. NOLDEN, JOSEFA OBEREM, JANINA FELS & IRING KOCH; *RWTH Aachen, Germany*

An auditory attention-switching paradigm (Koch et al., 2011) was combined with a task-switching paradigm. Participants heard two simultaneously presented words, a letter and a digit, which were spoken by a male and a female voice, and were each presented to one ear. A cue indicated which stimulus was the target-word in the trial - either by naming the target-speaker’s sex, the presentation-ear, or the content of the target (letter or digit). On a target-digit, participants had to

perform a size-categorization task, whereas on a target-letter, a consonant-vowel discrimination was required. Hence, the cue indicated the attention-set but not the task (or vice versa), and thereby induced a hierarchical sequence of attention-allocation and task-selection requirements. Attention- and task-switch costs were both present, and they interacted: In attention-switch trials the task-switch costs were reduced, and similarly, in task-switch trials reduced attention-switch costs were found. This deviates from findings of task-switching in hierarchical task structures, in which adjacent tasks were grouped to task-pairs, or chunks. Switching on this higher chunk-level dominated switching on the lower task-level - mainly by eliminating the reaction time benefit of task-repetitions. The idea that switches on hierarchically higher task-chunk-levels disrupt task-priming in repetition trials (Lien & Ruthruff, 2004) might need to be extended. Our findings indicate that lower-level switches disrupt higher-level repetition-priming similarly.

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**Sex differences in the Kimchi-Palmer tasks revisited: A possible role of impulsivity.** ANDREA SCH-  
EURINGER & BELINDA PLETZER; *Department of Psychology & Centre for Cognitive Neuroscience, University of Salzburg, Austria*

The Navon and the Kimchi-Palmer tasks are used to study global versus local processing. While the Navon task is a target detection paradigm, usually applied to participants under time-pressure, the Kimchi-Palmer task is a subjective similarity judgment task, in which participants decide, based on their subjective ratings, whether the target matches comparison stimuli at the global or the local level, with RTs being of secondary importance. Previous research, using the Navon task, indicated a global processing advantage for men and a local processing advantage in RTs for women, respectively. With the Kimchi Palmer task, sex differences, however, have only been observed in children, when focusing on the number of global or local choices. Deliberating more reflective decision processes in adults compared to children, we set out to investigate whether sex-differences in global-local processing in the Kimchi-Palmer task may be reflected in choice reaction times rather than in global versus local choices in adults. In different studies we therefore administered a computerized version of the Kimchi Palmer task in adult samples. The first study demonstrated that in a sample where no sex differences can be found in the number of global choices, women showed faster responses to local choices than men, who were faster in making global choices than women, which was irrespective of women’s menstrual cycle phase. In

a second study, these reaction time differences were related to participant's impulsivity. If participants are explicitly encouraged to respond faster, and to not think about their decisions, sex differences became apparent in the number of global versus local choices per se, which has been shown in a follow-up study.

These findings may shed new light in sex-dependent research concerning global vs. local processing and according to inconsistencies between children and adults.

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.. (3713) ..

**Practicing non-perceptual task preparation in task switching.** TILO STROBACH, STINA KLEIN & MIKE WENDT; *Medical School Hamburg, Germany*

In task switching studies, participants perform trials of task repetitions (i.e., the same task is executed in consecutive trials) and task switches (i.e., different tasks are executed in consecutive trials). Typically, reaction times are longer in switch trials compared to repetition trials (i.e., switch costs). Switch costs are usually reduced by lengthening of an interval following a cue that indicates the upcoming task, demonstrating effective task preparation. Previous studies found that the effect of the length of the cue-target interval on the switch costs was reduced after practice of switching between tasks that were associated with perceptually distinct stimulus dimensions. These reduced switch costs suggested that practice resulted in enhanced efficiency of perceptual preparation (i.e., preparation of attentional weighting of perceptual dimensions). To investigate the role of task switching practice for the preparation of non-perceptual task processes (e.g., increasing the readiness of the application of stimulus-response task rules), we applied a task switching paradigm, involving two digit magnitude and parity classification tasks which did not differ regarding their perceptual stimulus dimension, in six successive practice sessions. To further examine practice-related processing alterations on preparation, we intermixed trials of an Eriksen flanker task in the initial and the final session. Unlike the two digit tasks, which were always validly cued, the flanker task occurred randomly after a cue that indicated one of the other two digit tasks. Concerning the digit tasks, we replicated the findings of practice-related reductions of switch costs and their effect of the length of the cue-target interval. This suggested practice-related enhancement of preparation efficiency of non-perceptual task processes. In addition, flanker interference was larger after preparation for a task repetition than for a task switch and (regarding error rates) larger in the final than in the initial session. Possible

mechanisms underlying these attentional modulations are discussed.

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.. (3714) ..

**Visual search for action-controlled and uncontrolled events.** MICHAEL PILLING<sup>1</sup> & DOUG BARRATT<sup>2</sup>; <sup>1</sup>*Oxford Brookes University, United Kingdom*; <sup>2</sup>*University of Leicester, United Kingdom*

Perception and action are intimately related; perception guides our actions, but evidence suggests the actions we make can reciprocally influence our perceptions. We investigate the effect of action on perception in the context of visual search. In our task search displays consisted of 7-19 coloured ellipses. One item was the target (vertical/horizontal in orientation) and the rest were distractors (oblique in orientation). As the display was viewed the target and half the distractors periodically rotated 90-degrees. For the distractors this rotation occurred either at regular or irregular intervals. For the target there were three conditions. In one (action-controlled change) the target rotated each time the observer pressed a trigger-key -observers were instructed to press the key in a manner and at a rate which assisted them in finding the target. In the other two conditions (regular-uncontrolled-change; irregular-uncontrolled-change) the target changed orientation in a regular or irregular manner, similar to the earlier described distractors. The observer's task was to find the target vertical/horizontal item as quickly as possible and report its colour. Search for the two uncontrolled change conditions was highly inefficient for both distractor-behaviours. Much shallower slopes were found for the action-control trials, despite the average rate of the target change being lower. A further experiment indicated the advantage for action-controlled trials persisted with the pattern of change equated across controlled/uncontrolled conditions. Results show that search is more efficient for targets associated with action-controlled compared to uncontrolled events. Thus, action-control seems to influence the perceptual salience of a target within a search display, drawing attention towards it. This increased salience may be because the visual system 'binds' visual events associated with actions, or because making an action heightens expectancy of a change event occurring within a subsequent narrow time window.

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**Cognitive load in simultaneous interpreting.**

ALENA KONINA, TATIANA CHERNIGOVSKAYA, SVETLANA ALEXEEVA & VALERIA SUKHANOVA; *Saint Petersburg State University, Russian Federation*

Simultaneous interpreting was more than once labelled as one of the most requiring jobs there is. Though it seems that it does not equal listening to speech, translating and producing it again in another way. In our study we hypothesize that simultaneous interpreters would have a larger attention span than a control group doing a similar demanding task.

Procedure: Simultaneous interpreters (N=6) were asked to translate a video sequence where a speaker was giving a speech surrounded by 20 different objects. They were later presented with a recall test (20 target stimuli, 40 distractors) and comprehension questions. The control group (N=17) was instructed to shadow the speaker, press a button when he looked into the camera and to press another button when the speaker pronounced proper names creating a situation of significant cognitive load similar to one experienced by simultaneous interpreters.

Method: The eye movements were recorded via Eyelink 1000Plus.

Results: Although the difference in average fixation duration in groups seemed quite considerable (372 ms for interpreters and 396 for the control task), it did not reach significance ( $p=0,27$ ), while the percentage of time spent on the speaker (68% and 87% respectively) was found to be significant ( $p=0,014$ ).

Thus, the attention span of a simultaneous interpreter is different from that of a person not possessing this skill in a situation of cognitive load: it seems that interpreters tend to fixate less on the speaker which allows to perceive more incoming information.

This work was partially supported by RFBR, grant number 16-06-00501\_a.

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**When do second chances matter? Conditions under which second chances promote risky behavior.**

ROB NIJENKAMP, MARK R. NIEUWENSTEIN, RITSKE DE JONG & MONIQUE M. LORIST; *University of Groningen, Netherlands, The*

How does the prospect of a second chance influence human decision making? Second chances are prevalent in daily life, but to date not many empirical studies have investigated their effects. One practical example of second chances are resit exams, where an examinee is allowed to re-take or "resit" an exam until the exam is passed. Over the years, concerns have been expressed regarding

the benefit and fairness of such resit exams. In a series of experiments we investigated their potential effects on behavior regarding a first exam, or a first chance. Using an investment game, we established that the prospect of having a second chance leads to an increase in risky choices. The used investment game called for the investment of fictional study time on a fictional exam with the aim to pass that exam, given either one or two chances to do so. The relationship between the invested time and the chance of passing was given, essentially making the task an optimization problem that called for the strategic investment of one's resources. Following this line of reasoning, we propose that the established effects stem from a rational optimization of an inherent trade-off between the costs of investing study time and the benefit of passing the exam. In another experiment, we aimed to establish whether this effect would generalize to a situation in which actual learning would take place. Participants completed a paired-associates learning task and were subsequently tested, knowing there were either one or two chances to pass. The effect found in the investment game did not replicate in the learning task, thus raising the question under which conditions the prospect of a second chance induces risky behavior.

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.. (3717) ..

**An experimental examination of how working memory and mathematical expertise interact to influence Cognitive Reflections Test performance.**

ZOE PURCELL & COLIN WASTELL; *Macquarie University, Australia*

This study examined the interaction between working memory and expertise on the Cognitive Reflections Test (CRT). We tested the performance of novice, intermediate, and expert mathematicians on the CRT under a working memory load condition compared to a control non-working memory load condition. Novice mathematicians were comprised of psychology majors, intermediates were university students from mathematical majors, and experts were undertaking postgraduate studies or held postgraduate qualifications in mathematically focused fields. Novice mathematicians performed poorly on the CRT in both conditions. Intermediate mathematicians performed poorly under the working memory load condition but well in the control condition. Expert mathematicians performed well on the CRT in both conditions. These results are interpreted in terms of Complex Emergent Modularity theory with reference to Global Workspace theory and Predictive Processing.

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.. (3718) ..

**“Find Out”: a new tool for catching abductive reasoning at real-life work.** NATALIA ŻYLUK, DOROTA ŻELECHOWSKA & MARIUSZ URBANSKI; *Institute of Psychology, Adam Mickiewicz University in Poznań, Poland*

We present “Find Out”, a new tool for empirical research on abductive reasoning. “Find Out” allows for comprehensive evaluation of subjects’ abductive competence and for assessment of individual differences in solving abductive problems.

Abduction is a form of reasoning by which an individual aims at making sense of surprising or ambiguous phenomena. Although it is a ubiquitous type of reasoning both in everyday life and in various professional contexts (e.g. scientific or forensic investigation and clinical diagnosing), relatively few instruments enable carrying out empirical research on abduction. Moreover, they deliver only a very limited scope of information (exclusively quantitative indicators of a competence to generate hypothetical explanations). As we are interested in abduction as a real-life and compound form of reasoning – consisting of both generation and evaluation of hypotheses – we designed a new research tool.

“Find Out” is set up as a game that requires playing a role of an investigator seeking for an explanation of what has happened in presented enigmatic situation. The task consists of three time-limited stages that require forming and testing of hypotheses. The method enables to assess the abductive competence (understood both quantitatively and qualitatively) and individual’s reasoning style used in the course of solving abductive problem.

In our pilot studies we used “Find Out” along with a set of other measures (assessing deductive ability, divergent thinking, thinking styles, need for cognition, need for cognitive closure and auto-narrative inclination), allowing for exploration of the nature of individual differences revealing in the abductive competence and style.

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.. (3719) ..

**Why and when do people lie?** MARIA FRATESCU, ANDREA PITTARELLO & SEBASTIAAN MATHOT; *University of Groningen, Netherlands, The*

Ambiguous situations pose ethical challenges when people can benefit from dishonesty. Accordingly, people lie to the extent to which they can justify their cheating: this allows them to do wrong but feel moral. We tested the idea of justified dishonesty using eye tracking to examine the attentional processes underlying when and why people cheat. We presented participants with a circular arrangement of 8 digits, one of which was cued by a central line-segment, and asked them to indic-

ate the cued digit. Half were paid for the accuracy of their responses, the other half according to the value they reported (higher payments for higher values). We varied the ambiguity of the cue (sometimes it deviated slightly in the direction of another digit, the “second-cued digit”) and temptation of the second-cued digit (higher/lower than cued digit). We found that participants who were paid according to the reported value tended to (honestly) report the target, especially when it was high and the cue was unambiguous. However, as soon as the target value was lower than the second-cued digit (and thus, unprofitable), and the cue was ambiguous, participants tended to report the second-cued digit. When both the target and the second-cued digit were low, participants often reported neither, and simply reported the highest possible value (i.e., 8). This implies that, although participants generally report honestly, they make self-serving mistakes in ambiguous situations, and tend to resort to “brazen lies” when even self-serving mistakes are unattractive. Importantly, participants fixate their gaze on the digit that they will report from the very beginning of the trial, suggesting that decisions are made automatically, and don’t result from long deliberation.

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.. (3720) ..

**Perceptual load modulates bottom-up attentional capture.** KOEUN JUNG, SUKWON HAN & YOONKI MIN; *chungnam national university, Korea, Republic of (South Korea)*

The present study tested whether bottom-up attentional capture is affected by perceptual load. The perceptual load theory suggests that the target processing is impaired by an accompanying distractor when the perceptual load of the task is low, whereas the distractor exerts little effect under high perceptual load. This is because increased perceptual load exhausts attentional resources, leaving few to “spill over” to the distractor. What remains unclear is whether the efficient filtering out of the distractor under high load takes place even when spatial attention was oriented toward the distractor in a bottom-up manner. To test this, in the experiment, participants were asked to identify a target letter under varying perceptual loads. In the low load trial, the target was presented alone, whereas in the high load trial, the target was accompanied by three non-target letters. In each trial, a distractor, which could be compatible or incompatible the target letter, was presented. For a half of the total trials, a white square was presented for 40 ms, followed by the task stimuli. The cue was always presented at the distractor location, rendering it completely irrelevant with the task. The results showed that under low load, significant distractor interference was

found; the incompatible trial yielded significantly longer reaction time than the compatible trial ( $p < .001$ ). However, under high load, no such interference was found. Importantly, when the salient, but task-irrelevant cue was presented at the distractor location, distractor interference was magnified only under low perceptual load,  $p < .001$ , demonstrating that the cue captured attention and interfered with the performance of the task. Under high load, the cue did not impact task performance. These findings suggest that the bottom-up attentional capture by a salient, but task-irrelevant cue is modulated by perceptual load, challenging the strict automaticity of bottom-up attention.

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## Poster Session III S18, Tuesday, 10:40 – 12:00

.. (3801) ..

**Lexical access in second and first language speech production: Cognates facilitation and switching cost in Spanish children learning English.** DANIELA PAOLIERI, CARMEN AGUIRRE, ALMUDENA ORTEGA & TERESA BAJO; *University of Granada, Spain*

The present study establishes how second language learning children switch between the two languages during a picture-naming task. Two groups of Spanish children ( $n=40$ ; age range 11-16) with different degree of proficiency in English (L2) named pictures either in L1 or in L2 (blocked conditions), or they switched between the two languages (mixed condition). In addition, cognate status was manipulated. Event-related brain potentials and naming latencies were measured. In the blocked condition, a cognate facilitation effect was found for both groups of children in L2, but only for the high-proficiency group in L1. In addition, this effect in L1 was observed also in the mixed language condition for the high-proficiency group. On the contrary, the mixed language condition affected especially the medium-proficiency group that became slower in L1 than L2. Equals switching costs for both groups were found in L1 with slower naming times in switch trials compared with no-switch trials. These results showed how first language change according with the increase of proficiency in a second language. Different components associated with first language control and first language lexical effects are evidenced: with more language control of the first language in medium-proficiency group and more lexical permeability of the first language in high-proficiency group. A modulation in

the ERP waveforms for both effects was observed in time windows between 150 and 300 ms and 400-600 post-target presentation. The theoretical implications of these findings for current theories of second language acquisition are discussed.

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.. (3802) ..

**Can working memory training improve language production and comprehension in stroke aphasia? Results of a case-series study.** LILLA ZAKARIÁS<sup>1</sup>, CHRISTOS SALIS<sup>2</sup> & ISABELL WARTENBURGER<sup>1</sup>; <sup>1</sup>*University of Potsdam, Germany*; <sup>2</sup>*Newcastle University, United Kingdom*

**Background:** Emerging evidence suggests that training working memory (WM) can transfer to untrained higher-level cognitive functions when training tasks and outcome measures share underlying cognitive resources. But to what extent can WM improvement transfer to language production (i.e., informativeness and fluency of speech), functional communication (i.e., the participant's ability to convey a message in an everyday situation), and spoken sentence comprehension in aphasia?

**Method:** Three German-speaking individuals with chronic post-stroke aphasia practised two adaptive n-back tasks (one with pictures and one with spoken words) in two consecutive blocks. The training consisted of 16 sessions, over a four to five-week total training period. Before and after the training we administered the Amsterdam-Nijmegen Everyday Language Test (ANELT) together with spoken sentence comprehension tests and untrained experimental WM tasks. ANELT speech samples were transcribed and analysed for understandability (i.e., success to communicate a message), the number of words, the number of correct information units (CIUs), the percentage of correct information units (%CIU) and word fluency (i.e., CIUs/minute, words/minute).

**Results:** Participant 1 improved on both training tasks as well as on measures of the ANELT (i.e., understandability, %CIUs, CIUs/min) and an untrained WM task. Participant 2 improved on one training task and an untrained WM task, but did not improve on the ANELT. Participant 3 improved on one training task and measures of the ANELT (i.e., number of words, CIUs) without an improvement on the untrained WM tasks. Results of the spoken sentence comprehension tests will be discussed in the presentation.

**Discussion:** Our results suggest that WM can be improved in aphasia, which may lead to improvement on untrained WM tasks, language production, and functional communication. The mixed pattern of transfer detected in the present study warrants future research exploring the specific mechanisms underlying individual differences in

training outcome.

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.. (3803) ..

**Digital learning behavior: An eye-movement study of text and multimedia integration.** GAL BEN-YEHUDAH<sup>1</sup>, ORLY AZULAI<sup>2</sup>, Yael GILUTZ<sup>1</sup> & YORAM ESHET-ALKALAI<sup>1</sup>; <sup>1</sup>*Open University of Israel, Israel*; <sup>2</sup>*Tel Aviv University, Israel*

In digital learning environments, multimedia elements (e.g. text, pictures, videos) are often displayed side-by-side. Despite the increasing use of such displays, it is not clear how learners integrate information from different media sources and whether different integration strategies affect comprehension. In the present study we used eye-tracking technology to examine patterns of information integration between textual and visual-multimedial elements that were displayed simultaneously. We asked (1) does the quality of integration influence the comprehension of digital material, and (2) does the use of an explicit cue, signaling the learner to transfer his gaze from textual to multimedial elements, influence text comprehension. The cue we used was a visual symbol embedded at the end of four key sentences in the text. Twenty-nine undergraduate students were randomly assigned to either the experimental (text with cue) or control (text without cue) group. Participants read a digital text on photosynthesis, which included a labeled scientific illustration and an interactive simulation. Then the learning material was removed and a comprehension test was administered. Using an area of interest (AOI) analysis, the number of eye-movements between text-based AOIs and multimedia AOIs served as a proxy for the level of information integration. As expected, 62% of the experimental group showed high levels of integrative eye-movements, whereas only 31% of the control group showed similar eye-movement behavior. However, performance on the comprehension test did not differ between the groups. When only participants with high levels of integration behavior were examined, those in the control group had higher comprehension scores (73% success) than those in the experimental group (63% success). A possible interpretation of this finding is that adult readers have formed stable learning strategies suitable for them; thus, an instruction (via an explicit cue) to gaze at the multimedial material may have interfered with their personalized learning process. Email: galby@open.ac.il

.. (3804) ..

**Long-lasting memory advantage for produced words with familiar and unfamiliar accents.** ANN-KATHRIN GROHE & ANDREA WEBER; *University of Tübingen, Germany*

Own overt word productions facilitate word recall more than listening to others producing the words (MacLeod, 2011). This production advantage applies both for words with an accent that is familiar to participants, and for words with an unfamiliar accent. The effect was also observed when participants did not hear themselves while speaking during training (Grohe & Weber, 2017). How stable the production advantage can be over a longer period of time, was tested in the present study.

Seventy-five (54 female) speakers of the Swabian German accent participated. Test words either had a Swabian accent marker that was familiar to participants (/st/ pronounced as [ʔt], Zahnbür[ʔt]e – ‘tooth brush’) or an unfamiliar Northern German accent (/ʔt/ pronounced as [st], Blumen[st]rauß – ‘bouquet’). In the initial training phase, words were presented on a computer screen and participants either read the words aloud with the Swabian or Northern German accent marker (following the explicit instruction to do so), or they listened to the accented words. After training, participants decided in a visual memory recognition task for individual words from the training phase (old words) and new words with a button press whether each word was old or new. D-primes (accounting for hit rates and false alarms) were significantly higher for self-produced words than listened-to words ( $\chi^2=23.3$ ;  $p<.001$ ), when the test followed immediately after the training. This advantage applied to both the familiar and the unfamiliar accent. When participants completed the lexical decision task only one week after the training, produced words were still more likely recalled than listened-to words ( $\chi^2=6.8$ ;  $p<.009$ ). Thus, the process of production is as general to strengthen word memory across accents and as powerful to produce a long-lasting memory advantage.

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.. (3805) ..

**Training the production of syllables, not their perception, influences subsequent productions.** AUDREY BÜRKI<sup>1,2</sup> & MALTE VIEBAHN<sup>2</sup>; <sup>1</sup>*University of Potsdam, Germany*; <sup>2</sup>*University of Geneva, Switzerland*

Background. The present study tests the hypothesis that speakers and listeners use the same phonetic encoding units when producing and perceiving speech. Previous studies reported that the time it takes speakers to produce syllables depends on their frequency, and that at least part of this effect originates in the phonetic encoding process. The present study examines whether repeated exposure to syllables influences the time to subsequently produce these syllables, and whether this influence differs if training involves the overt production of the syllables or their mere auditory pro-

cessing.

**Method:** Participants were trained on high frequency, low frequency, and non-existing syllables in either a perception or production task on two days. On the third day, they named pseudowords in immediate and delayed tasks. The first syllables of these pseudowords were either trained in the perception task, trained in the production task, or untrained.

**Results.** Response latencies in the delayed naming task were entered as a covariate in the statistical model for the immediate response latencies. The model revealed main effects of syllable type ( $p < 0.01$ ) and exposure modality ( $p < 0.01$ ), the two variables did not interact ( $p = 0.22$ ). Novel syllables were produced with longer response latencies than high frequency or low frequency syllables, and training in production resulted in shorter response latencies (872 ms) compared to training in perception or absence of training (884 ms and 889 ms, respectively). Syllables trained in the perception task and untrained syllables did not differ.

**Discussion.** The findings suggest that the speed with which abstract scores for syllables are retrieved from memory or assembled is influenced by the recent production of these syllables. They provide no evidence that previous auditory exposure to syllables influences the phonetic encoding process.

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.. (3806) ..

**The object manipulability effect in speech production.** ANNA LORENZONI, FRANCESCA PERESSOTTI & EDUARDO NAVARRETE; *University of Padova, Italy*

The mere vision of objects automatically triggers motor simulation for using them. The implications of this motor simulation in tasks that do not require object-use is still a matter of debate in cognitive sciences. Here we test whether motor simulation percolates to the linguistic system by exploring the effect of object manipulability in a speech production task. Twenty-four Italian native speakers name as quickly and accurately as possible the set of photographs provided by Guerard, Lagacé and Brodeur (Beh Res Meth, 2015). Photographs were normalized on four motor dimensions based on how easily an object 1-can be grasp; 2-can be move; 3-can be pantomime; and 4-the number of actions can be performed with the object. Analyses of the naming latencies show classical psycholinguistic phenomena on object naming such as age of acquisition and name agreement. Critically, linear mixed-effects models show an effect of all the four motor predictors over and above the psycholinguistic phenomena. Specifically, reaction time are faster for more manipulable objects, replicating previous

findings (Guerard et al., 2015). The manipulability facilitation effect is discussed in the context of current theories that argue a causal link between motor simulation and language processing.

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.. (3807) ..

**Age-related effects in compound production – intact lexical representations but more effortful encoding.** ANTJE LORENZ<sup>1</sup>, STEFANIE REGEL<sup>1</sup>, PIENIE ZWITSERLOOD<sup>2</sup> & RASHA ABDEL RAHMAN<sup>1</sup>; <sup>1</sup>*Humboldt-Universität zu Berlin, Germany*; <sup>2</sup>*Westfälische Wilhelms-Universität, Münster*

The production of nominal compounds (e.g., lipstick) in the presence of morphological, semantic and unrelated distractor words (picture-word interference paradigm) was examined in young and older healthy speakers to test models of speech production and lexical representation. The presence of constituent distractors of compound targets (lip or stick for the target lipstick) speeded compound naming, while naming was slowed by distractors that were categorically related to the compound as a whole (powder -> lipstick). No effects were obtained for distractors from the same semantic category as the first constituent of compound targets (toe -> lipstick). These effects were present in both age groups, and indicate that compounds are stored holistically at the lemma level, but as morphemes at the word-form level of the production lexicon, unaffected by age. Main effects of age revealed overall slower picture naming and less accurate responses in the elderly. The older speakers showed enhanced morphological facilitation for first-constituent distractors, while semantic distractor effects were unaffected by age. In a non-verbal attentional control task (Simon task), the older speakers were slower overall and showed larger processing costs than younger ones in the conflict (incongruent) condition. Non-verbal attentional control had no impact on overall naming latencies, but specifically affected morphological processing in the elderly. Word-finding difficulties in older speakers seem to result from deficient links between intact lexical-semantic and lexical form representations, resulting in less fluent morpho-phonological encoding in the elderly.

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.. (3808) ..

**Effects of semantic neighbourhood density on picture naming in unimpaired speakers and people with aphasia.** SOLÈNE HAMEAU<sup>1,2</sup>,

LYNDSEY NICKELS<sup>1,2</sup> & BRITTA BIEDERMANN<sup>2,3</sup>;  
<sup>1</sup>*Department of Cognitive Science, Macquarie University, Australia;* <sup>2</sup>*ARC Centre of Excellence in Cognition and its Disorders, Macquarie University, Australia;* <sup>3</sup>*School of Psychology and Speech Pathology, Curtin University, Australia*

Evidence from priming and word-picture interference tasks makes it clear that activation of words related in meaning can interfere with production of that word (e.g., Howard et al, 2006; Schnur et al, 2006; Schriefers et al, 1990). However, it is less clear the extent to which semantically-related words influence word production without previous presentation of this 'neighbour'. Different effects of semantic neighbourhood are reported, and disentangling these effects is complicated by the use of different measures (e.g., Bormann, 2011; Kittredge et al., 2007; Mirman, 2011). This study had three parts:

Experiment 1 investigated the interrelationships between the six measures of semantic neighbourhood that have been used in previous studies: using principal component analysis, four independent factors were derived related to four types of neighbour: Featural, associative, contextual and distant semantic neighbours.

Experiment 2 used these factors to determine the effects of semantic neighbourhood on picture naming by 50 unimpaired speakers (data from Székely et al., 2003). Regressions predicting naming RT found that none of the four semantic neighbourhood factors had a significant effect.

Experiment 3 analysed the effects of the same semantic neighbourhood factors on picture naming of 193 people with aphasia from the Moss Aphasia Psycholinguistic Project Database (MAPPD; Mirman et al., 2010) using Generalised Mixed Effects models for binomial outcomes and, for a reduced group (n=140), the interactions of these factors with impairment. For both groups, feature-based neighbourhood predicted accuracy but did not interact with degree of semantic or phonological impairment. For errors, words with many feature-based neighbours were more likely to be correctly named than result in omissions and phonological errors, and were more likely to result in a semantic error than to be omitted.

The theoretical implications of these results will be discussed but they seem to be best accommodated within interactive theories of word production.

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.. (3809) ..

**The availability of literal meaning in idiom processing: A self-paced reading study.** SARA DONNELL BECK & ANDREA WEBER; *University of Tübingen, Germany*

Holsinger and Kaiser (2013) examined the effects of contextual expectations on reading times of phrasal verbs. They found that the cost of recovery in expectation violations is greater when a literal interpretation is expected than when a figurative interpretation is expected. More generally, access to figurative language is dependent on context while literal language is readily available. While research on the use of context in idiomatic processing confirms that preceding context eases access to figurative meaning (Cieslicka et al. 2014), access to a literal interpretation is also affected by the literality of the idiom (Titone, Connine 1994). This ambiguity varies across idioms: For example, "break the ice" has a clear literal and figurative meaning, but the idiom "lose one's cool" does not.

In an English self-paced reading study, we investigated the extent that congruent preceding context eases the processing of literal and figurative readings of idioms varying in literality. Following two norming studies, controlling for strength of context and plausibility of the sentences involved, we conducted a phrase-by-phrase reading study on 47 American English speakers using highly literal and non-literal idioms embedded in sentences. Preceding contexts either supported the literal or the figurative interpretations of the idioms and were followed by disambiguating phrases that were either congruent or incongruent with the context provided (e.g., [The new school boy]/[The cold Eskimo]...just wanted to break the ice [with his peers]/[on the lake]...). The results point to a difference in context effects for literal and non-literal idioms. For literal idioms, the cost of an unexpected resolution is present both for figurative and literal contexts; for non-literal idioms, only figurative contexts induce this cost for unexpected resolutions. Our results support Holsinger and Kaiser's (2013) findings in literal idioms, but also suggest that highly conventional figurative language does not necessarily undergo literal processing.

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**Do you trust foreigners? Impact of a foreign accent on cognitive processes.** ALICE FOU-CART<sup>1</sup>, HERNANDO SANTAMARÍA-GARCÍA<sup>2,3,4</sup> & ROBERT HARTSUIKER<sup>1</sup>; <sup>1</sup>*Ghent University, Belgium*; <sup>2</sup>*Pontificia Universidad Javeriana, Colombia*; <sup>3</sup>*Instituto de Neurociencia Cognitiva y Traslacional (INCyT), Argentina*; <sup>4</sup>*Centro de memoria y cognición intellectus hospital san Ignacio, Argentina*

When a sentence like 'Ants don't sleep' should be assessed as equally true (or false) independently of the speaker's accent, it does not seem to be the case (Lev-Ari & Keysar, 2010). Using event-related potentials, we examined the impact of a foreign accent (FA) on sentence processing, credibility and memory. First, participants were introduced to four speakers that differed in their accent (native or foreign accent) and social status (high or low status, based on achievements). Participant then played a visual discrimination game with these speakers, and always ended up in the middle rank. This hierarchy phase (Zink et al., 2008) identified two superior speakers (native and foreign accent) and two inferior speakers (native and foreign accent). Participants were then presented with sentences containing true, false or unknown information ('One of the colours of the French/Gabonese flag is blue/green), along with the photo of one of the speakers. Their task was to assess the statement (true, maybe true, maybe false, false, don't know). Importantly, sentences were presented visually to investigate the long-lasting impact of a FA, not the impact of a FA on online linguistic fluency (e.g., phoneme distortion). Finally, participants were presented with some of the sentences they had read, and had to indicate which of the four speakers had said it. Preliminary results show that participants were more likely to assess a statement as false when it was said by the superior FA-ed speaker than by the superior native speaker. Also, early (N400) and late (P600) ERP differences revealed that information given by the superior FA-ed speaker and that given by the superior native speaker was not processed similarly. The memory task suggests better recollection for superior native > superior FA > inferior native speakers. Overall, FA seems to have a long-lasting impact on cognitive processes.

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**Automatic letter-sound integration, reading development and dyslexia: A behavioural investigation.** FRANCINA CLAYTON<sup>1</sup> & CHARLES HULME<sup>2</sup>; <sup>1</sup>*UCL, United Kingdom*; <sup>2</sup>*University of Oxford, United Kingdom*

Background: Learning to read an alphabetic language requires the formation of associations

between letters and their corresponding speech-sounds. Recent research proposes that reading difficulties in children with developmental dyslexia may arise from a specific deficit in establishing automatic letter-sound associations. Using series of experiments, this research is one of the first behavioural investigations to assess the contribution of automatic letter-sound integration in the reading performance of both typically developing (TD) and dyslexic children.

Method: A large sample of TD children (aged between 4-10 years) and twenty children with dyslexia (aged between 9-10 years) completed standardized reading measures and an experimental priming task designed to measure the extent to which letters and speech-sounds are automatically integrated.

Results: Both TD and dyslexic children were significantly faster to identify an auditory speech-sound when primed by a congruent visual letter than when primed by a novel symbol with no associated speech-sound ( $p < .001$ ) or an incongruent visual letter ( $p < .001$ ). This significant priming effect is interpreted as evidence of automatic letter-sound integration. Furthermore, results from this research found that the size of this priming effect (i.e. the extent of automatic letter-sound integration) did not predict unique variance in reading performance.

Discussion: Contrary to the hypothesis that dyslexia reflects a deficit in automatic letter-sound integration, the present research shows that both dyslexic and TD children show automatic activation of speech-sounds from printed letters. Furthermore, the extent of automatic integration does not appear to predict variation in children's reading performance. Rather, baseline performance on this task (simply deciding if a sound is speech-sound or not) is predictive of reading performance, which arguably provides further evidence of the importance of phonological skills for the development of decoding.

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**Shared vs. independent syllabic representations in late bilinguals.** ANNETT B. JORSCHICK<sup>1</sup>, KIARA F. ABAD BRUZZO<sup>1</sup> & JOANA CHOLIN<sup>2</sup>; <sup>1</sup>*Bielefeld University, Germany*; <sup>2</sup>*Ruhr-University Bochum, Germany*

Speakers' ability to produce fluent speech might rely on stored high-frequency (HF) syllables. These stored syllables facilitate speech planning relative to a slower segment-by-segment assembly route that is used to construct novel or low-frequency (LF) syllables. Evidence for stored syllables comes from studies showing that HF-syllables are produced faster than LF-syllables (Cholin, Dell &

Levelt, 2011; Laganaro & Alario, 2006). Most previous work focused on monolingual speakers. A study by Alario, Goslin, Michel, & Laganaro (2010) investigated syllable-frequency effects in early and late high-proficiency Spanish-French bilinguals. Their findings indicate that early bilinguals access independent language-specific syllabic representations when speaking their respective languages, while late bilinguals seem to rely on language-shared representations. To further investigate the (dis-)entanglement of syllabic representations in bilingual speech, we tested syllable-frequency effects in late Spanish-German bilinguals of varying proficiency in German.

Using rigorously constructed materials controlling for segmental and metrical factors, participants produced German HF- and LF-syllables in a symbol-associating production task (Cholin et al., 2010). Language dominance was evaluated through self-assessment.

The results revealed a significant interaction between the factors Syllable Frequency and Language Dominance: Speakers who were less proficient in German showed an inverse syllable-frequency effect (HF-syllables yielding slower RTs than LF-syllables) while speakers with a higher proficiency-level showed no difference between HF- and LF-syllables (with a trend towards a facilitatory syllable-frequency effect). Dominance assessment proved all participants to be Spanish dominant. Thus, participants may have relied on Spanish syllable representations when producing German syllables. Ongoing analyses, taking Spanish-to-German syllable correspondences into account, imply that Spanish syllable frequencies may have impacted German production times.

Against the background of the Alario et al. data, our results suggest that late bilinguals with a lower proficiency-level in German may rely on Spanish syllable representations to construct German syllables anew before they gradually acquire language-specific representations.

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#### **Parafoveal semantic processing in visual search for words: A Fixation Related Potentials study.**

JULIEN DAMPURÉ & HORACIO BARBER; *Department of Cognitive Psychology, Universidad de La Laguna, La Laguna, Spain*

The question of the ability to process the meaning of parafoveal words has recently known a new impulse with the use of the Fixation-Related Potentials (i.e. simultaneous recording of the EEG and eye movements). In the reading literature, recent studies have demonstrated that the meaning of the right parafoveal word could be processed when the word at fovea was easy to process (i.e. low foveal

load, see Lopez-Perez et al., 2017). By contrast, few studies have questioned how words are processed during visual search, that is how multiple words are processed at a time in order to guide the next eye movement. Accordingly, we present a study using the FRPs in which participants had to report the absence or the presence of target-words in displays of three-words: one in the center and two in the parafovea (either semantically-related or unrelated). Since the amount of cognitive resources would be a strong determinant of the efficiency of parafoveal processing, we manipulated two sources of cognitive load, namely the foveal and task-related cognitive loads. Concretely, two different tasks manipulated cognitive load: participants searched for target-words either given in advance (i.e. literal task), or defined by their semantic category (i.e. categorical task). The foveal load was manipulated by varying the lexical frequency of the centered word and its semantic-relatedness with the target. Preliminary results revealed early modulations of the N1 and frontal P2 components by the semantic relatedness of the parafoveal word according to foveal and cognitive loads. These results extend our comprehension of the time course of parafoveal processing of multiple words and how the availability of cognitive resources constrains fast semantic processing of parafoveal words.

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#### **Individual differences in lexical skills influence the inhibitory orthographic neighbourhood frequency effect in lexical decision but not in progressive demasking.** STEPHANIE MATHEY & EMILIE DUJARDIN; *University of Bordeaux, France*

The aim of the present study was to examine whether lexical competition effects between orthographically similar word representations can be influenced by lexical skills of adult readers in visual recognition of French words presented in lexical decision and progressive demasking tasks. We investigated lexical competition by comparing stimulus words with one higher-frequency orthographic neighbour differing from the stimulus by the deletion of one letter (e.g., *pliage* [folding]/*plage* [beach]), with words with no such neighbour (e.g., *argile* [clay]). According to previous data from the lexical decision task (LDT) in English and Spanish (Davis, Perea, & Acha, 2009), we expected an inhibitory deletion neighbourhood frequency effect in French, a language in which lexical competition is assumed to develop easier than in English. This effect was also predicted in the progressive demasking task (PDMT), a task reputed to increase lexical competition effects. More importantly, we assumed that this effect which relies on coding letter position uncertainty should be sensit-

ive to readers individual differences in lexical skills. In total, 93 adults participated in the LDT (Experiment 1) and 92 participated in the PDMT (Experiment 2). Lexical skills of the participants were assessed with spelling, reading, and vocabulary tests for the French language (see Andrews, 2015, in English). The results showed the expected inhibitory deletion neighbourhood frequency effect on word response times in both experiments. Individuals with low lexical skills also responded slower and less accurately than individuals with high lexical skills in both experiments. Finally, we found a reliable interaction between the group of lexical skills and deletion neighbourhood frequency on word response times in the LDT but not in the PDMT. These data are interpreted in the theoretical framework of interactive activation and competition in visual word recognition, according to both individual differences in lexical skills and specific demands of the tasks.

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**Lexical knowledge boosts statistically-driven speech segmentation in young adults.** SHEKEILA PALMER<sup>1</sup>, LAURENCE WHITE<sup>2</sup> & SVEN MATTYS<sup>1</sup>; <sup>1</sup>University of York, United Kingdom; <sup>2</sup>University of Plymouth

Speech segmentation is largely driven by stored lexical knowledge. In the absence of lexical knowledge however, non-lexical heuristics are called upon (acoustic, segmental, prosodic). In three experiments, we investigated the effect of lexical knowledge on statistical learning. Following a large literature, we started with an artificial language containing four trisyllabic nonwords and observed the standard above-chance recognition memory performance in a subsequent 2AFC task. We then replaced one of the four nonwords with a real word (tomorrow) and noted improved segmentation of the three nonwords. This improvement was maintained when the real word was a different length than the nonwords (philosophy), ruling out an explanation based on rhythmic expectations. The improvement was also maintained when the word was added to the four original nonwords, rather than replacing one of them. Together, these results show that for young adults recognisable portions of speech in an otherwise meaningless stream serve as anchors for discovering new words. However, recent data from our lab indicates that older adults do not show same benefit. Mechanisms supporting the enhancement of statistical learning by lexical knowledge are discussed.

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**Is Bilingualism Associated with Enhanced Executive Control? A Meta-Analysis.** MINNA LEHTONEN<sup>1,2</sup>, ANNA SOVERI<sup>1,3</sup>, AINI LAINE<sup>1</sup>, JANICA JÄRVENPÄÄ<sup>1</sup>, ANGELA DE BRUIN<sup>4</sup> & JAN ANTFOLK<sup>1,3</sup>; <sup>1</sup>Department of Psychology, Abo Akademi University, Finland; <sup>2</sup>Department of Psychology and Logopedics, University of Helsinki, Helsinki, Finland; <sup>3</sup>Turku Brain and Mind Centre, University of Turku, Turku, Finland; <sup>4</sup>Basque Center on Cognition, Brain and Language, Donostia, Spain

#### Background

Bilingualism has been associated with superior performance in tasks requiring executive functions (EF), assumedly reflecting bilinguals' massive experience of managing the two languages. However, despite extensive investigation, research has not yet produced a comprehensive picture on the nature of the putative bilingual advantage. Moreover, the field has been found to suffer from publication bias (de Bruin et al., 2015). The aim of this meta-analysis is to study in which EF domains and tasks, if any, the advantage is consistently observed. We also consider a number of study-, task-, and participant-related variables previously suggested to moderate the effects.

#### Method

To take into account publication bias (de Bruin et al., 2015), we included both published articles and unpublished theses in the analysis. Literature search was performed via PsycINFO, Google Scholar, and various dissertation databases. We included studies conducted on healthy adults comparing a group of bilinguals to a group of monolinguals in at least one EF task that was relatively common (> 5 samples) in the whole set of studies. The measures were categorized to one of the following six domains: Inhibitory Control, Shifting, Monitoring, Working Memory, Attention, and Verbal Fluency. The analysis included 150 studies with 889 effect sizes.

#### Results and Conclusion

After removing outliers, a multi-level meta-analysis, accounting for dependent effect sizes, showed a very small but significant bilingual advantage for the domains Inhibition, Shifting, and Working Memory. We also found a small but significant bilingual disadvantage for Verbal Fluency. After correcting for bias, the aggregated effect sizes did not significantly differ from zero. Further, the moderator analyses did not support theory surrounding the putative bilingual advantage. Our meta-analysis shows that, when taking into account publication bias present in the field, no significant bilingual advantage is observed in any of the six included domains of EF.

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**Cognate word processing: The effect of deviant-letter position.** PILAR FERRÉ<sup>1</sup>, JUAN HARO<sup>1</sup> & MONTSERRAT COMESAÑA<sup>2</sup>; <sup>1</sup>*Department of Psychology and CRAMC. Universitat Rovira i Virgili, Spain;* <sup>2</sup>*Human Cognition Lab, CIPsi, School of Psychology, University of Minho, Portugal*

It has been shown that letter position influences reading processes. For example, the first letter of a given string is usually processed preferentially. However, this line of research has focused almost exclusively on monolingual word processing. Indeed, only two masked priming lexical decision studies (Comesaña, Coelho, Oliveira, & Soares, in press; Font, 2001, unpublished) explored how letter position affects word reading in bilinguals. While the second one is in line with monolingual literature as it showed that the recognition of cognate words (translation equivalents sharing form; e.g., tomato-tomate [English-Spanish]) is affected by the position of the deviant letter (the position of the letter that differs between translation equivalents, e.g., paper-papel), the first one failed to show differences. Thus, the aim of the present research is to further examine this issue with highly-proficient Catalan-Spanish bilinguals by employing two different tasks (priming lexical decision task [Experiment 1] and a two alternative forced choice task [2AFC, Experiment 2]). Note that if cognate word recognition is affected by deviant-letter position, the input-coding scheme of one of the most influential models of bilingual memory (the BIA+, Dijkstra et al., 2010) needs to be amended, since it does not assign a special role to any letter position. The experimental stimuli comprised 240 Catalan-Spanish translation pairs, half of which were cognate words. Cognates were divided into five conditions regarding their deviant letter (from first position [e.g., xifra-cifra, “figure”] to last position [e.g., matriu-matriz, “matrix”]). Results showed effects of the deviant-letter position only in the 2AFC task. In particular, participants were more accurate when it was the first letter the one that differed between translation equivalents, but they committed more errors when they were presented with translation equivalents that differed in the penultimate letter. These results are discussed in relation to the BIA+ model.

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**Letter confusability, lexical skills and orthographic neighbourhood frequency interact in visual word recognition.** EMILIE DUJARDIN<sup>1</sup>, GAËL JOBARD<sup>2,3,4</sup> & STÉPHANIE MATHEY<sup>1</sup>; <sup>1</sup>*Laboratoire de Psychologie, EA4139, Université de Bordeaux, France;* <sup>2</sup>*Université de Bordeaux, Institut des Maladies Neurodégénératives, Groupe d'Imagerie Neurofonctionnelle, UMR 5293, F-33000 Bordeaux, France;* <sup>3</sup>*CNRS, Institut des Maladies Neurodégénératives, Groupe d'Imagerie Neurofonctionnelle, UMR 5293, F-33000 Bordeaux, France;* <sup>4</sup>*CEA, Institut des Maladies Neurodégénératives, Groupe d'Imagerie Neurofonctionnelle, UMR 5293, F-33000 Bordeaux, France.*

Many studies have shown that lexical similarity influences visual word recognition. One of the most investigated lexical similarity effect is the orthographic neighbourhood frequency effect (NFE) showing that words with at least one higher frequency neighbour (e.g., trail/train) are longer to identify than words with no such neighbour (Grainger et al., 1989). The aim of this study was to examine whether confusability of the substituted letter could influence the NFE in visual word recognition, depending on individual differences in lexical skills of French readers. Letter confusability corresponds to the visual similarity between a letter and other letters of the alphabet (e.g., o and a are highly confusable letters, while m and p are not). The NFE was investigated by comparing words (e.g., flacon [flake] and calorie [calorie]) with only one orthographic neighbour which was either of higher frequency or lower frequency than the stimulus (e.g., flacon [bottle] or colorie [colour] respectively). The confusability of the substituted letter between the stimulus and its neighbour was either high (e.g., flocon [flake]/flacon [bottle] in the high-frequency neighbour condition, and calorie [calorie]/colorie [colour] in the low-frequency neighbour condition), or low (e.g., chameau [camel]/chapeau [hat] in the high-frequency neighbour condition, and clavier [keyboard]/clapier [hutch] in the low-frequency neighbour condition). The word stimuli were presented in a standard lexical decision task. The lexical skills of the participants were assessed with tests of reading, orthographic and vocabulary levels. The results showed a letter confusability x neighbourhood frequency x vocabulary interaction. More precisely, the inhibitory NFE was stronger when confusability of the substituted letter was low rather than high, and even more so when the vocabulary level of the participants was high rather than low. The results are explained within the framework of interactive activation and competition models of visual word recognition (Davis, 2010; McClelland & Rumelhart, 1981).

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**Do French dyslexic children use syllables in visual word processing?** NORBERT MAÏONCHI-PINO<sup>1</sup>, CÉLINE LESEURE<sup>2</sup> & VIRGINIE LOISEAU<sup>1</sup>; <sup>1</sup>Université Clermont Auvergne - LAPSCO - CNRS UMR 6024, France; <sup>2</sup>Université de France Comté, France

Some recent studies in French have shown that dyslexic children, who have phonological deficits, were surprisingly able to use phonological syllable-sized units during online visual word processing. French dyslexic children were as sensitive as chronological age-matched and reading level-matched children to phonotactic and statistical properties of syllables to access and segment words. This questions the nature of the phonological deficit: degraded phonological representations vs. impaired access to the phonological representations. To further determine whether – and how – French dyslexic children are able to use syllable-based reading strategies, we designed a lexical decision task using a visual masked priming paradigm which allowed us investigating how: 1/ automatic is the syllable activation as segmental and prelexical unit; 2/ both the phonological frequency and orthographic co-occurrences of the initial segments of words influence a syllable-based lexical access; 3/ the importance of phonologically-driven response patterns depend on the requirements of the task. Twenty-nine French children who exhibited the three main dimensions of the phonological deficit and 58 typically developing school-aged children participated (chronological age-matched and reading level-matched controls). Our preliminary results (analysis in progress) are threefold: 1/ dyslexic children show a syllable priming effect; 2/ dyslexic children show the classical inhibitory syllable frequency effect with high-frequency syllables; 3/ dyslexic children are sensitive to the orthographic co-occurrences of the initial bi- and trigrams. Our results point out that dyslexic children unexpectedly had “automatized” abilities to use syllable-based reading strategies; their response times were slightly slower – but as accurate – than those in chronological age-matched controls. The syllable-based segmentation and lexical access rely on hierarchically-ranked properties (phonological frequency then orthographic co-occurrences). We discuss our results towards the validity of the hypothesis of a degraded access to the phonological representations in French children with developmental dyslexia.

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**The Baseword Frequency Effect in Children's Pseudohomophone Reading.** SIMON TIFFIN-RICHARDS & SASCHA SCHROEDER; *Max Planck Institute for Human Development, Germany*

#### Background

The baseword frequency effect reflects that response latencies in the lexical decision task (LDT) to non-words derived from high frequency base-words (e.g., GREAN from GREEN) are shorter than those from low frequency basewords (e.g., SLEAT from SLEET). One explanation for this effect is that the orthographic representations of high frequency basewords are easier to access. This allows a quick progression to a verification stage in which the exact spelling of a stimulus is checked, upon which the lexicality decision is then based. We investigated whether this verification mechanism is modulated by the quality of the orthographic lexicon.

#### Method

A sample of 196 German-speaking children in fourth grade took part in a LDT and spelling assessment. The item pool consisted of 40 high frequency and 40 low frequency words. Non-words were derived from the words by exchanging a single letter to create pseudohomophones (Bant, Band, engl. ribbon). Participants were presented 80 trials in a fully crossed lexicality (word vs. pseudohomophone) by frequency (high vs. low) design.

#### Results

Linear mixed effect models were used to analyze the response time and accuracy data. We found a significant baseword frequency effect in response latency. Importantly, good spellers showed a greater baseword frequency effect in their response accuracy to non-words than poor spellers. Good spellers thus had an advantage in verifying the spelling of pseudohomophones with high frequency basewords, due to their higher specification of high frequency orthographic representations.

#### Discussion

Our generalization of the baseword frequency effect to children supports the activation-verification account of visual word recognition. We found that the baseword frequency effect in response accuracy was greater for children with high spelling ability. This supports the assumption that the verification mechanism draws on frequency sensitive orthographic representations and relies on their specificity to detect deviations when ascertaining the lexicality of a letter-string.

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## Poster Session IV Ground, Wednesday, 10:40 – 12:00

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**Stronger effects of self-generated than cue-induced expectations when verifying predictions in data graphs.** MAIKE KEMPER<sup>1</sup>, ROBERT GASCHLER<sup>2,1</sup> & TORSTEN SCHUBERT<sup>3,1</sup>; <sup>1</sup>Humboldt-Universität zu Berlin, Germany; <sup>2</sup>FernUniversität in Hagen; <sup>3</sup>Martin-Luther-Universität Halle-Wittenberg

Expectations can come in different forms when analysing and presenting data. Researchers can display a graph with predictions before presenting the graph containing the research results, they can verbally cue the audience or, alternatively, they can have the audience generate predictions for themselves. Prior studies have documented stronger behavioural and EEG effects of self-generated as compared to cue-induced expectations. While participants presumably cannot help but use their own expectations, they might sometimes ignore cues, especially when these are of low validity. In the current study, ignoring cues semantically was not possible. As stimuli we used graphs showing either a linear upward or downward trend. We compared the impact of cues (verbal and visual) and self-generated predictions on the performance of participants checking their current prediction against a presented data graph (similar or differing direction of trend). Different from prior studies, the setup allowed for within-experiment comparison of different cue formats and (a certain amount of) cue processing was necessary to successfully complete the task. Nevertheless we found that self-generated predictions had a stronger impact than cues. Verbal cues had a stronger effect than visual cues without verbalization. Responses to graphs with a linear upward trend were faster and were influenced more strongly by predictions, than the response to graphs with a downward trend. In addition we explored whether negating expectations (for example “not upward” instead of “downward” or crossed out graphs as visual cues) have different influences depending on expectation format. The pattern of results for negated expectations was very similar to those for affirmative expectations.  
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.. (4002) ..

**The interplay of response selection and visual attention is modulated by visual attention demands.** CHRISTINA B. REIMER & TORSTEN SCHUBERT; Martin-Luther-Universität Halle-Wittenberg, Germany

Response selection and visual attention are limited in capacity. According to the central bottleneck model, the response selection processes of two tasks in a dual-task situation are performed sequentially when both tasks are presented at high temporal overlap. In conjunction search, visual attention is required to select items and to bind item features (i.e., color, form), which results in a serial search process. Search time consequently increases as items are added to the search display (i.e., set size effect). In the present study, we investigated the open question whether response selection and visual attention (i.e., feature binding) rely on a common or on distinct capacity limitations. If response selection and visual attention share a common capacity limitation, they would be processed sequentially. However, if response selection and visual attention rely on distinct capacity limitations, they would be processed concurrently.

In both dual-task experiments, participants completed two tasks presented with an experimentally modulated temporal interval between them (Stimulus Onset Asynchrony, SOA). Task 1 was an auditory two-choice discrimination task and Task 2 a conjunction search task in which the target had to be detected among variable numbers of distractors. In Experiment 1, the visual attention demands in conjunction search Task 2 were lower, as each item consisted of two features. In Experiment 2, the visual attention demands were higher, as each item in conjunction search Task 2 consisted of four features.

In both experiments, we analyzed conjunction search time according to the locus-of-slack method. In Experiment 1, response selection and visual attention were processed concurrently showing that both processes rely on distinct capacity limitations. In Experiment 2, response selection and visual attention were processed sequentially revealing that both processes share a common capacity limitation. To conclude, the visual attention demands modulate the interplay of response selection and visual attention.

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.. (4003) ..

**The locus of attention in Picture-Word Interference and Stroop effects: an eye-tracking study.** FLAVIA DE SIMONE, ALESSIA COPPOLA & SIMONA COLLINA; Università degli Studi Suor Orsola Benincasa, Italy

The aim of this study was to compare the locus of attention in the picture-word interference and the Stroop paradigm. This issue has been previously studied (Roelofs, 2007; 2014). However the experiments used different materials and procedures according to the paradigms. In the present study both the tasks were presented to the same

participants and the response set was controlled. Three pictures and three colors were presented at two different SOA (0 and 500 milliseconds) in three different conditions, namely congruent with the distractor corresponding to the name of the picture (arm/ARM, green/GREEN), incongruent with a semantic relation between the distractor and the name of the picture (arm/LEG, green/RED), neutral with a row of X as distractor (arm/XXXXX, green/XXXXX). Each naming task appeared on the left of the screen and was accompanied by a manual task, on the right of the same screen, consisting in the identification of the direction of an arrow (XX<XX or XX>XX). Participants were instructed to perform first the naming task and later the manual task. To control the attentional demand the visual behavior of participants was monitored by FaceLab eye tracker and the time to first fixation in the different portions of the screen, left and right corresponding to the different tasks, was controlled for each trial. The data evidenced similar pattern for the two paradigms with longer response times in the incongruent condition at both the SOA. In addition, in the incongruent condition eye movements from the left to the right of the screen resulted anticipated respect to the congruent and neutral condition. The results will be discussed in the lexical competition hypothesis framework.

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**The perceived difficulty of T1 encoding impacts the AB.** ELLEN MACLELLAN, DAVID SHORE & BRUCE MILLIKEN; *McMaster University, Canada*

The Attentional Blink is a pronounced deficit in the ability to identify a second target item (T2) if it appears in close temporal proximity to a first target item (T1). There is general consensus that this deficit is the result of limited capacity encoding processes that are unavailable to encode T2 until T1 encoding is complete. We have previously investigated the extent to which the allocation of attentional resources to T1 encoding is driven by either the actual or the perceived difficulty of T1 encoding, dependent on the context in which T1 is presented. For example, it is possible to induce an AB for easy to encode T1 trials, when they are presented in the context of difficult to encode T1 trials. Moreover, the time course of the context effect appears to differ as a function of the nature of the control processes engaged (i.e., proactive vs. reactive). To investigate these issues further, we presented easy and difficult T1 items in a mixed design and manipulated factors that might allow participants to reliably distinguish between the two trial types. In Experiment 1 we manipulated the colour of the T1 distractor, and found that this manipulation was ineffective. In Experiment 2, we manipulated the loca-

tion of presentation of T1 items and found some evidence that T1 encoding is influenced by stimulus location. Overall, our results demonstrate a range of context effects on perceived difficulty, which in turn modulate the magnitude and time course of the AB.

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**Deadly Attraction - Attentional Bias Towards Preferred Cigarette Brand in Smokers.** MAKSYMILIAN BIELECKI<sup>1</sup> & DOMARADZKA EWA<sup>2</sup>; <sup>1</sup>*SWPS University of Social Sciences and Humanities, Department of Psychology, Warsaw, Poland;* <sup>2</sup>*Polish Academy of Sciences, Institute of Psychology, Warsaw, Poland*

Numerous studies have shown that biases in visual attention might be evoked by affective and personally-relevant stimuli, for example addiction-related objects. Despite the fact that addiction is often linked to specific products and systematic purchase behaviors, no studies focused directly on the existence of bias evoked by brands. Smokers are characterized by high levels of brand loyalty and everyday contact with cigarette packaging. Using the incentive-salience mechanism as a theoretical framework, we hypothesized that this group might exhibit a bias toward the preferred cigarette brand. In our study, a group of smokers (N = 40) performed a dot probe task while their eye movements were recorded. In each trial a pair of pictures was presented – each of them showed a single cigarette pack. The visual properties of stimuli were carefully controlled, so branding information was the only factor affecting subjects' reactions. For each participant, we compared gaze behavior related to the preferred vs. other brands. The analyses revealed no attentional bias in the early, orienting phase of the stimulus processing and strong differences in maintenance and disengagement. Participants spent more time looking at the preferred cigarettes and saccades starting at the preferred brand location had longer latencies. In sum, our data shows that attentional bias toward brands might be found in situations not involving choice or decision making. These results provide important insights into the mechanisms of formation and maintenance of attentional biases to stimuli of personal relevance and might serve as a first step toward developing a new attitude measurement techniques.

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.. (4006) ..

**Can rewards enhance error awareness? A study in younger and older adults.** ELISA DI ROSA, FABIO MASINA, ANTONINO VALLESI & DANIELA MAPELLI; *University of Padova, Italy*

**Background.** Recent studies demonstrated that the presence of motivational incentives, like rewards, can enhance attention, perception and memory performance in both younger and older adults. However, little is known about their effect on error awareness (EA), crucial aspect of a successful error processing that significantly decreases during aging.

**Method.** 60 healthy participants (30 younger and 30 older adults) were tested both with the standard Error Awareness Task (EAT; Hester et al., 2005), i.e. a Go/No-go task in which is requested to signal every error commission, and with a "motivational EAT", identical to the standard one except for the presence of rewards delivered after both correct responses and aware errors. Between and within group differences were mainly evaluated in terms of EA and post error slowing (PES), calculated both after aware and unaware errors.

**Results.** As expected, significant differences were found between EAT and motivational EAT. However, the direction of these effects was somewhat counterintuitive. In fact, the presence of rewards caused a slightly worsening of performance, with slower response times, lower accuracy and, moreover, lower EA in both groups. Results also showed that the presence of rewards significantly increased the mean PES in older adults only. Finally, in the motivational EAT there was no difference between PES after aware and unaware errors, which on the contrary was significant in both groups when performing the standard EAT.

**Discussion.** Taken together, these findings suggest that the employment of motivational incentives, at least when delivered through visual stimuli, is not an effective strategy to enhance EA. A possible explanation of this pattern could lie on both the top-down and bottom-up effects of the reward itself on attentional orienting. [EDR and AV are funded by the European Research Council grant No. 313692 (FP7/2007-2013) to AV]

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.. (4007) ..

**The influence of emotion and individual differences on visual search: A functional near-infrared spectroscopy study.** ROBERT C. A. BENDALL, PETER EACHUS & CATHERINE THOMPSON; *University of Salford, United Kingdom*

The visual world is cluttered and it is impossible to attend to all items and areas simultaneously due to a limited capacity processing system. Selective visual attention is subject to a range of influences,

one of which is emotion. Recently it has been argued that individual difference traits may mitigate the impact of emotion on visual attention and search. Neuroimaging research has suggested that the neural circuits underpinning top-down cognitive control and emotion regulation include the prefrontal cortex, and increased prefrontal cortex activity when regulating emotion has been shown to predict symptom severity reduction in depressive patients. This study investigated if emotion and individual differences influence visual search. Using a neuroscientific approach, the study also sought to investigate whether brain activity is related to individual difference traits that are linked to emotional processing during visual search. Participants were required to locate a target embedded within real-world scenes of varying emotional valence under differing mood conditions. Self-report affect ratings were collected to demonstrate levels of psychological affect. Variations in prefrontal cortex blood oxygenation were recorded using functional near-infrared spectroscopy to measure activation of brain regions implicated in cognitive control and emotion regulation. Task performance was measured by collecting accuracy and reaction time in the visual search task. Findings show effects of both emotion and individual differences and results are discussed in relation to current models of top-down cognitive control and emotion regulation.

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**Adjustment of Extent and Timing of Distractor-Based Response Activation in the Temporal Flanker Task.** KERSTIN JOST<sup>1</sup>, MIKE WENDT<sup>2</sup>, AQUILES LUNA-RODRIGUEZ<sup>3</sup>, ANDREAS LÖW<sup>3</sup> & THOMAS JACOBSEN<sup>3</sup>; <sup>1</sup>Brandenburg Medical School, Germany; <sup>2</sup>Medical School Hamburg, Germany; <sup>3</sup>Helmut-Schmidt-University/University of the Federal Armed Forces Hamburg, Germany

Nominally task-irrelevant stimuli often influence performance. The most prominent evidence is the congruency effect: Responses are slower when the irrelevant, distracting stimulus and the target are associated with different (incongruent) responses than when they are associated with the same (congruent) response. Presenting the distractor in advance of the target (i.e., the temporal flanker task) offers the possibility to investigate distractor processing uncontaminated by target processing. In previous studies, it has been observed that both the extent and timing of distractor-based response activation (indicated by means of the lateralized readiness potential, LRP) can be adjusted to contextual factors, i.e., when distractor utility and target onset is (reliably) predictable. Aim of the present study was to investigate whether and how distractor information is used when target on-



set is unpredictable. To this end, stimulus-onset asynchronies (SOA) of 350 and 1000 ms were either fixed or mixed within blocks. With SOA fixed, the onset of the distractor-based LRP was adjusted to target onset. In contrast, with mixed SOAs, LRPs occurred early for both SOAs. However, when the target turned out to be delayed, the initial rise of the LRP was followed by a marked decrease and a subsequent second rise timed to target onset. Again, LRP effects were larger when the proportion of congruent trials was high and the distractor, thus, highly predictive of the target/response (i.e. high distractor utility). Our findings suggest that strategic usage of distractor information under conditions of unpredictable target onset is enabled by an early rise of response activation to ensure an appropriate bias for responding when the target occurs early. In case this activation turns out to be premature, response activation is temporarily inhibited and then regained in a usefully timed way (rather than being maintained until target occurrence).

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.. (4009) ..

**Two sides of a coin: Performance contingency modulates effects of monetary reward on proactive control.** ULRIKE SCHULZ, HANNES RUGE, ANNETTE BOLTE & THOMAS GOSCHKE; *TU Dresden, Germany*

Rewards motivate individuals to optimize task performance by recruiting effortful strategies and mobilizing preparatory proactive control. Proactive control involves the active maintenance of goal-relevant information to reduce interference from irrelevant information that might trigger alternative goals. In marked contrast to the robust findings on effects of performance contingent reward, studies examining effects of rewards that were unrelated to behavioral performance (performance non-contingent reward) yielded heterogeneous results. Here, using the same task, we directly compared the effects of monetary rewards on proactive control as a function of the performance contingency of the rewards. To this end, 110 adults performed a variant of the AX-continuous performance task. They were randomly assigned to one of two reward groups, receiving either performance contingent or performance non-contingent monetary rewards. Additionally, we assessed reward-related individual differences with the BIS/BAS questionnaire (Carver and White, 1994). Results showed that reward effects depended significantly on performance contingency. While performance contingent reward reliably and strongly increased proactive control, performance non-contingent reward slightly reduced proactive control. This was the case even though the two groups did not differ significantly in reward sensitivity. The present results

provide further evidence on dissociable influences of reward on effortful control. While performance contingent rewards had a strong motivational effect on proactive control, the effect of performance non-contingent rewards was similar to that of task-irrelevant mild positive affect, suggesting a dissociation between motivational and emotional effects of reward.

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.. (4010) ..

**Temporal dynamics of conflict processing across childhood (5-to-15 years): Evidence from distribution analyses in the Simon task.** SOLÈNE AMBROSIO<sup>1</sup>, BORIS BURLE<sup>2</sup> & AGNÈS BLAYE<sup>1</sup>; <sup>1</sup>*Laboratoire de Psychologie Cognitive - CNRS UMR 7290 & Aix Marseille University, France;* <sup>2</sup>*Laboratoire de Neurosciences Cognitives - CNRS UMR 7291 & Aix Marseille University, France*

The Simon task is a popular task to investigate inhibition, a core component of cognitive control (Diamond, 2013). Distribution analyses of accuracy and response times in adults allowed dissociating an early activation of the incorrect response that is followed by a rapid suppression (van den Wildenberg et al., 2010).

In children, the development of conflict processing has been mainly reported in terms of a quantitative reduction of the congruence effect thereby preventing the examination of the developmental course of the activation/suppression processes. The aim of this study was to fill this gap. We focus on the Simon task data of a large cohort (360 5-to-15-year-old children performing three conflict tasks). A child-adapted version of the task displaying colored pictures of two animals was used in which children had to press one of two lateralized keys indexing the color of the displayed animal.

As expected, congruence effect on response times was significantly reduced when comparing 5- and 15- year-olds. However, this increase of interference control evolved very gradually with no significant change when contrasting consecutive age groups, there is also no change when considering congruence effect on accuracy. This was the case for both raw and proportional congruence effect.

Distributions analyses revealed striking similarities across all age groups. At all age groups, fast responses on incompatible trials were more error-prone than slow ones, indicating a fast « automatic » and transient activation of the incorrect response. Moreover, the chronometric congruence effect decreased as RTs get longer, showing effective suppression of the incorrect response. Findings of efficient suppression and activation already at 5 years but in a time scale far longer than in 15 year-olds throws new light on (a) the automatic character of activation and (b) the contribution of the relative

timing of activation and suppression to the development of conflict processing.

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.. (4011) ..

**Studying the relevance of alerting and acoustic intensity features in visuospatial interference paradigms.** PAOLA CAPPUCCI<sup>1</sup>, ÁNGEL CORREA<sup>1</sup>, RICO FISCHER<sup>2</sup>, TORSTEN SCHUBERT<sup>3</sup> & JUAN LUPIÁÑEZ<sup>1</sup>; <sup>1</sup>*Departamento de Psicología Experimental, Universidad de Granada, Spain.*; <sup>2</sup>*Institut für Psychologie, Ernst-Moritz-Arndt Universität Greifswald, Germany.*; <sup>3</sup>*Institut für Psychologie, Martin-Luther-Universität Halle-Wittenberg, Germany.*

Previous studies reported increased interference effects when a task-irrelevant acoustic alerting signal preceded target presentation in conflict tasks. However, the alerting-congruence interaction was observed for Flanker and Simon conflict tasks but not for Stroop tasks. These findings led to the assumption that alerting signals widen the attentional focus and facilitate processing of irrelevant spatial characteristics.

Therefore, in two experiments we designed a combined Simon and spatial Stroop task to test the impact of an alerting signal on processing of irrelevant spatial characteristics. In addition, we tested the influence of alerting signal intensity on the alerting-congruence interaction. For the Simon task, results confirmed an increased interference effect provoked by the presence (Experiment 1) and intensity (Experiment 2) of alerting signals. In contrast, presence or intensity of alerting signals did not affect the interference effects in the spatial Stroop task. These findings suggest that the impact of alerting signals primarily depends on the type of conflict (e.g., S-R conflict in Simon compared to S-S conflict in Stroop) but less so on the processing of irrelevant spatial attributes. Together, our results provide support for the hypothesis that alerting signals facilitate automatic response activation processes, e.g., a more efficient transmission of stimulus codes into response codes (Fischer, Plessow, & Kiesel, 2010).

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.. (4012) ..

**Effect of relevant-but-non-target features on interference in feature search mode.** YOUNGLAE KIM, YOONKI MIN & YOUNGCHANG LEE; *Chungnam national university, Korea, Republic of (South Korea)*

A large number of studies have established that even salient color distractor could not interfere in specific shape target detection during maintaining feature search mode. Recent research, however, showed that interference in feature search mode could be generated with changeable color distractors. According to this, the augmented number of

to-be-ignored feature might affect search strategy, resulting in interference even in feature search mode. Here, we investigated whether bottom-up element can generate interference in feature search mode regardless of search strategy. To test this, two different displays (non-uniform or uniform non-targets) were employed. The shape of all non-targets was square in uniform display. Two of non-targets were different shapes (diamond and triangle) in non-uniform display. In the experiment, participants were asked to detect a specific shape as a target while ignoring any other distractors. To maintain feature search mode, non-uniform displays were presented until first 60 trials, excluded from analysis, and then two different displays were randomly intermixed from trial to trial. The results showed that in both display types, significant interference from irrelevant-color was found; response times in distractor-presence trials were longer than those in distractor-absence trials ( $p < .05$ ). In addition, the difference between interferences of each displays was found ( $p < .05$ ). Interference from color distractor in uniform displays was larger than that in non-uniform displays, indicating that the shape of non-targets might influence the amount of interference from irrelevant-but salient color distractor even when feature search mode was maintained. This finding suggests that interference in feature search mode can also be generated by bottom-up factor.

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**Stopping at a Red Light: Recruitment of Inhibitory Control by Environmental Cues.** SHACHAR HOCHMAN<sup>1</sup>, EYAL KALANTHROFF<sup>2</sup> & AVISHAI HENIK<sup>1</sup>; <sup>1</sup>*Ben-Gurion University of the Negev, Israel*; <sup>2</sup>*The Hebrew University of Jerusalem, Israel*

What is the effect of environmental cues on high cognitive operation? In the current study, we used traffic light stimuli as familiar environmental cues in a stop-signal task. In the task, participants had to press corresponding buttons to red, yellow and green traffic light stimuli and inhibit response in 25% of the trials due to auditory cue. Following the 'horse race model' (Logan, 1994), we applied simultaneous tracking procedures on the stop-signal delay and separately analyzed no-stop reaction times (nsRT) and stop-signal reaction times (SSRT). By doing so, we were able to examine the inhibitory control components for each color. Our results showed it was easier to stop for a stopping-related environmental cue as indicated by shorter SSRT for a red light compared to a yellow or green light stimuli. Accordingly, we suggest that inhibition can be automatically evoked by a strongly associated environmental cue.

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.. (4014) ..

**Binding Errors are Affected by Size Congruity.**CHEN TAL, ISABEL AREND & AVISHAI HENIK; *Ben Gurion University of the Negev, Israel*

The visual system successfully binds the physical (e.g., size, color) and the semantic (e.g., numerical value) dimensions of stimuli. It has been shown that the semantic distance between two numbers (e.g., 2 - 4 vs. 1 - 6) affects binding of shape and color. It is still under debate whether binding involving numerical value and physical size is influenced by attention. For example, in the size congruity effect (SiCE), individuals are faster in comparing the larger of two numbers when the physical size and the numerical value of the stimulus matches (e.g., small 2 large 4) as opposed to when it mismatches (e.g., small 4 large 2). One assumption is that saliency associated with the stimulus' physical size may bias attention, increasing the SiCE. We further examined the influence of attention in the SiCE by analyzing the occurrence of illusory conjunctions (ICs) in the SiCE. If binding of numerical value and physical size occurs pre-attentively, there should be less ICs for congruent relative to incongruent trials. In two experiments participants reported the color of the larger number while fixating on a letter task. In Experiment 2, participants reported both the color and the identity of the larger number. The numerical distance (large and small) and congruity, involving numerical value and physical size (congruent and incongruent), were manipulated. Both experiments replicated our previous findings showing more ICs for large, rather than small, numerical distance. Contrary to our hypothesis, there was no difference in ICs for congruent and incongruent trials. In Experiment 2, when ICs were analyzed based on number incorrect reports, there were more ICs for incongruent trials. Taken together, these results suggest that binding of physical size and number does not occur outside the focus of attention.

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.. (4015) ..

**Modifying influence of temperament on performance in cognitive tasks.**ALEKSANDRA KROLL; *Pomeranian Medical University, Poland, Poland***Background**

The psychology of individual differences has brought many results pointing to differences among groups of people. Among them is temperamental difference seen mostly in personality traits which are closest to the biological and innate characteristics.

Different temperamental profiles are reported to be related to strengths and weaknesses in coping, even with increased risk of mental disorders. In persons with different characteristics of tempera-

ment there are also reported differences in cognitive functioning, e.g. attention. The purpose of our study was to investigate whether temperamental traits are also noticeable in strategies used in solving relatively short cognitive tasks.

**Methods**

A group of 30 volunteers took part in an experimental procedure. The procedure consisted of a task based on choice reaction time task model. The levels of temperamental traits were measured by EPQ-R (Eysenck Personality Questionnaire-Revised) and FCZK-T which is a self-assessment questionnaire basing on a Strelau's Regulatory Theory of Temperament (RTT), (Strelau, 1996). We analysed differences in mean reaction time, performance duration and performance efficiency.

**Results**

Significant differences in strategies between persons with high levels of FCZK-T's variable briskness were observed. Also subjects with significant differences in endurance (one of FCZK-T's variable) levels showed lower error rate and lower time reaction variance during the experiment. We also observed differences in variances analysis of people of different extraversion levels (measured by EPQ-R) although they were not significant.

**Discussion**

Our findings show that there are significant differences between subjects with particular temperamental profile in performing cognitive tasks. It has been shown that cognitive functions can influence the expression of temperamental features in behaviour. The question of the direction of influence is open to interpretation. However our findings support the hypothesis of the modifying influence of temperamental features on the executive functions. Email: kroll.at@gmail.com

.. (4016) ..

**How face-to-face experimental layout affects verbal fluency performance: the role of social interaction and anxiety.**FANNI FRUZZINA KISS<sup>1,2</sup>, ZOLTÁN ILLYÉS<sup>1,2</sup>, MENTA HAVADINAGY<sup>1,2</sup>, PÉTER SIMOR<sup>1,2</sup>, KAROLINA JANACEK<sup>1,2</sup> & DEZSŐ NÉMETH<sup>1,2</sup>; <sup>1</sup>*Eötvös Loránd University, Hungary*; <sup>2</sup>*MTA-ELTE NAP B Brain, Memory and Language Research Group, Institute of Cognitive Neuroscience and Psychology, Research Centre for Natural Sciences, Hungarian Academy of Sciences, Budapest, Hungary*

Verbal fluency tasks are frequently used in experimental psychology and neuroscience, as well as in neuropsychological testing and clinical screening. However, fluency performance can be strongly affected by the social context, the layout of the experiment and anxiety. We tested this hypothesis by using a special experimental design: In one condition the experimenter and the participant were in

a face-to-face experimental layout, which is similar to the classical clinical situation, while in the other condition the experimenter was behind the participant, which is more similar to a psychoanalytic therapy layout. Forty-nine participants performed letter and semantic fluency tasks in both conditions (in a counterbalanced order). The level of anxiety was assessed by the Spielberger Trait-State Anxiety Inventory (STAI) before performing the fluency tasks. We found no differences in verbal fluency performance between the two conditions and no relationship between participants' trait anxiety and fluency performance. However, higher state anxiety was associated with better letter fluency performance in the face-to-face condition. These findings can deepen our understanding of the interaction between experimental layout, anxiety and cognitive performance.

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.. (4017) ..

**An exploration into the effects of ageing on general control of attention during route learning in a complex environment.** CHRISTOPHER HILTON<sup>1</sup>, SEBASTIEN MIELLET<sup>2</sup>, TIM SLATTERY<sup>1</sup> & JAN WIENER<sup>1</sup>; <sup>1</sup>Bournemouth University, United Kingdom; <sup>2</sup>University of Wollongong, Australia

Age related spatial navigation deficits in route learning are well described, however the contribution of changes in attentional processes to this deficit are less well understood. Hartmeyer, Grzeschik, Wolbers and Wiener (under review) recently employed a reaction time probe paradigm to assess attentional engagement during route learning in healthily aged adults and younger controls using a simple virtual environment. They found the same modulation of attention throughout route learning for both younger and old adults – larger engagement at high information regions of the route. The current study aimed to determine if these results would be replicated using a complex realistic environment. Further, gaze behaviour was recorded as an exploratory investigation to examine if differences in general control of visual attention whilst route learning could help explain deficits seen in older adults as compared to younger adults. Behavioural results were in line with the literature, showing route learning deficits in older adults. Modulation of attention across high and low information regions was consistent with findings from Hartmeyer et al. and older adults showed increased engagement at high information regions relative to younger adults. This may be due to older adults dedicating more resources in total, or to older adults having a reduced pool of resources available. There was no difference in general eye movement parameters whilst route learning between older and younger adults. General control of attention in terms of modulation of engagement

and oculomotor behaviour does not appear to be a factor in age related decline in route learning ability, although other visual attention factors such as selection and inhibition are avenues for further research.

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**What is the magnitude of Speaking-Induced Suppression during word utterances? – An EEG study using Real-time Speech Exchange.** ANDREAS LIND<sup>1,2</sup>, DAVIDE RIGONI<sup>1</sup>, PETTER JOHANSSON<sup>2,3</sup>, LARS HALL<sup>2</sup>, BJÖRN BREIDEGARD<sup>2</sup> & ROBERT HARTSUIKER<sup>1</sup>; <sup>1</sup>Gent University, Belgium; <sup>2</sup>Lund University, Sweden; <sup>3</sup>Uppsala University, Sweden

The concept of Speaking-Induced Suppression (SIS) refers to the phenomenon that N100/M100 responses are dampened when speakers receive unaltered auditory feedback of their own utterances of for example the vowel [a:], compared to when they receive concurrent altered auditory feedback or listen to a recording of the same utterances. SIS has previously been interpreted as evidence for a forward modelling function during speech. Ventura et al. (2009) varied the complexity of vowel utterances and found that SIS was reduced with increased utterance complexity. In the present experiment, we investigate the effect on SIS when utterance complexity is increased even more. While measuring brain activity with EEG as 20 participants uttered actual monosyllabic words, we used Real-time Speech Exchange to occasionally manipulate their auditory feedback by exchanging their utterances so that they said one word but simultaneously heard themselves saying another word. Preliminary data analysis shows an N100 component for both exchange and control conditions. Upon visual inspection, these components look very similar in magnitude, but we do not yet know if there is a statistical difference between them. Beyond the N100, the components observed during the manipulated trials appear to be very similar to those observed for overt self-produced speech errors: there is a clear Feedback-Related Negativity (FRN) peaking at 200 ms after speech onset, followed by a pronounced P300 component. This indicates that, at least starting from around 200 ms, the brain processes the inserted words in a way similar to how it processes errors in self-produced speech. This further indicates that the FRN and P300 components, when seen in circumstances when actual speech errors are made, are due to external, rather than internal monitoring. We will discuss the relevance of our results for forward modelling of speech.

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.. (4019) ..

**Exploring the hidden states of auditory and visual working memory.** MICHAEL WOLFF<sup>1,2</sup>, GÜVEN KANDEMİR<sup>1</sup>, MAAIKE RIETDIJK<sup>1</sup>, MARK STOKES<sup>2</sup> & ELKAN AKYÜREK<sup>1</sup>; <sup>1</sup>*University of Groningen, The Netherlands*; <sup>2</sup>*University of Oxford, United Kingdom*

It has been shown that a neutral visual “impulse” presented in the delay of a visual working memory (WM) task elicits a content-specific neural response as measured by EEG. This impulse-response could reflect the temporary changes in the neural connectivity of the underlying WM network, the “hidden” state. In order to further explore the mechanisms underlying these findings and, more specifically, to test if the impulse response is modality specific, we ran both an auditory and a visual WM experiment and recorded EEG. In each trial, two items were serially presented: randomly orientated gratings in visual, and random pure tones in the auditory task. After a short delay, a retro-cue indicated which of the previously presented stimuli was relevant and would be tested. After another short delay, two impulses, a visual flash and an auditory tone, were serially presented. At the end of the trial a forced-choice probe was presented in both experiments. The neural response of the visual impulse presented in the delay of the visual WM task was specific to the previously cued but not the uncued item, replicating previous findings, and providing further evidence that the impulse-response is specific to WM content. The auditory impulse did not evoke an item specific response in the visual task, however. Furthermore, both the visual and the auditory impulse showed little content-specificity in the auditory task, suggesting that the impulse response may be specific to visual WM.

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**Reward expectancy modulates corticospinal excitability depending on action requirements during task preparation.** CARSTEN BUNDT, LARA BARDI, MARCEL BRASS & WIM NOTEBAERT; *Ghent University, Belgium*

Action preparation has been associated with transient primary motor cortex (M1) suppression before target onset. This effect has been shown to vary depending on individuals' motivation. It remains unclear, however, whether motivational effects on M1 are contingent upon action preparation. We devised a rewarded Go/NoGo cue-target delay paradigm where an action cue (300ms) indicated whether individuals were required to execute a response (Go) or not (NoGo) at target onset. Thereafter, a short fixation period (600ms) followed and a motivational cue was presented (300ms), indicating whether participants could receive reward (+1)

or not (+0) on the current trial for accurate performance. After a short delay period (600ms), the target was presented in the form of a circle left or right from fixation, requiring individuals to provide a left or right index finger response, respectively. Transcranial magnetic stimulation (TMS) was applied over left M1 and electromyography (EMG) was obtained from the right first dorsal interosseous (FDI). TMS could be applied during three different time epochs: a) within the jittered inter-trial-interval in order to assess baseline corticospinal excitability (200ms before action cue onset), b) early (100ms) or c) late (500ms) within the motivational cue-target delay period. Relative to baseline, results showed heightened corticospinal excitability followed by a sharp decrease for Go trials early after a reward predicting cue compared to a no-reward predicting cue. In contrast, NoGo trials tended to show general suppression irrespective of reward information. These findings suggest that motivational effects on M1 depend on action requirements during task preparation.

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.. (4021) ..

**Working memory updating under tDCS in healthy adults.** KAROLINA MAGDALENA ŁUKASIK<sup>1</sup>, MINNA LEHTONEN<sup>1,2</sup>, JUHA SALMI<sup>1,2</sup>, MARCUS MEINER<sup>3</sup> & MATTI LAINE<sup>1,4</sup>;

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**Background:** Several studies have examined the effects of transcranial direct current stimulation (tDCS) on cognition, including working memory (WM). However, the efficacy of this technique in enhancing WM is not yet clearly established. Using a well-controlled design, we examined whether single-session tDCS has effects on working memory (WM) updating performance as measured by a verbal 3-back task. We compared three conditions: anodal, cathodal and sham, targeting the left ventrolateral prefrontal cortex.

**Methods:** We tested 33 healthy, right-handed adults (all university students, 23 females). In a double-blind design, each participant completed 3 sessions, receiving anodal, cathodal or sham stimulation. The sessions were performed on separate days. Each session consisted of three 10-minute blocks, separated by self-timed pauses. The first block served as baseline measurement for a given session. In the second block, participants received stimulation or sham, and in the third block they completed the task with no stimulation. Session order was counterbalanced.

We used the EMS BrainStim device. The anode was placed over left inferior frontal gyrus (F7 according to the 10-20 system), and the reference electrode on the right side of the forehead.

In case of both anodal and cathodal stimulation, we used a 1.5 mA current. In the sham condition, the participants experienced a 40-second electric current of 1.5 mA at the beginning and end of the 10-minute interval.

Results: N-back accuracy was measured with d-prime scores and reaction times were calculated for correct trials. In the ANOVAs, no significant main effects or interactions were found for either cathodal or anodal stimulation. Only a significant effect of block was observed, suggesting practice-related performance improvement towards the end of the session.

Our study fails to find effects of left ventrolateral prefrontal tDCS on WM updating in healthy adults. Possible reasons for these results will be discussed. Email: klukasik@abo.fi

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**Neural representations of model updating and surprise of temporal expectations: an fMRI study.** ANTONINO VISALLI<sup>1</sup>, MARIAGRAZIA CAPIZZI<sup>1</sup>, ILARIA MAZZONETTO<sup>1,2</sup> & ANTONINO VALLES<sup>1,3</sup>; <sup>1</sup>*Department of Neuroscience, University of Padova, Italy*; <sup>2</sup>*Department of Information Engineering, University of Padua, Italy*; <sup>3</sup>*San Camillo Hospital IRCCS, Venice, Italy*

It is well-established that we are able to predict when a relevant event might occur and to flexibly update prior temporal expectation weighting current evidence. Theoretically, these processes thus seem to obey to the Bayesian rule. However, a direct modeling of how the brain updates temporal expectation within a Bayesian framework is poorly explored. In the present study, we combined a temporal preparation task with the excellent spatial resolution of fMRI to address this issue. Participants were required to respond to the onset of a target that followed a neutral warning signal. The foreperiod between warning and target was drawn from a Gaussian distribution, which was kept constant across the trials of a block but that, critically, changed across different blocks. To quantify updating, we used the Bayesian rule to compute for each trial the posterior probability of target onset. Then, the Kullback-Leibler divergence (DKL) between the posterior and the prior probability of target onset was used to model the fMRI data. Furthermore, the temporal nature of our paradigm allowed us to easily dissociate between updating and surprise associated with the occurrence of low probable target onsets. Since during a trial target onset probability changed as a function of elapsed time (hazard rate),

surprise was defined as the Shannon information (Is) associated with the probability of target onset given the hazard rate. Although DKL and Is are usually strongly correlated, here high degree of updating sometimes occurred concurrently with low surprise. Results showed the involvement of the anterior cingulate cortex and prefrontal areas, especially the right dorsolateral prefrontal cortex, in updating temporal expectation, and of the posterior parietal cortex in dealing with surprising events. Overall, our findings help clarify how the brain behaves to predict temporal events. This work was funded by the ERC-Starting Grant LEX-MEA n° 313692 (FP7/2007-2013).

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.. (4023) ..

**A task independent brain signature of multilingual early visual word recognition.** SABRINA ARISTE<sup>1</sup>, ALIETTE LOCHY<sup>2</sup>, BRUNO ROSSION<sup>2</sup> & CHRISTINE SCHILTZ<sup>1</sup>; <sup>1</sup>*University of Luxembourg, Luxembourg*; <sup>2</sup>*University of Louvain, Belgium*

In monolinguals, abstract word representations are accessed as early as 160 ms. Despite large evidence for parallel and interactive activation of lexical knowledge in both languages known by bilinguals, there is no clear proof for such an early access to a non-native lexicon. This study demonstrates fast parallel lexical activation in native and second/third languages by means of the fast periodic visual stimulation technique and EEG analysis. We presented German and French words block wise as oddball (1/5) within four frequent stimulus conditions: Strings of consonants, word-derived illegal non-words, and language specific pseudowords (German and French). German and French native speakers that were also late learners of French/German were tested in a color change detection of a central fixation cross, while the alphabetic stimuli were rapidly flashed (10 Hz stimulation frequency). Early lexical access occurred for both native and non-native languages, as demonstrated by a brain response at the oddball stimulation frequency and its harmonics for both German and French words within non-words. Strikingly, the amplitude of this oddball response reflected the proficiency in the two languages at a group, as well as an individual level. The smallest amplitude of the brain oddball response was recorded for pseudowords derived by the dominant language. Altogether, these results show early access to multilingual word representations, converging with data from monolinguals. Resolving the previous discrepancy between the time course of lexical access for native and non-native languages, our findings support models of bilingual word recognition that assume parallel lexical activation of

multiple known languages from early stages. They also show that oddball responses in visual steady states can be employed as an objective measure of (multilingual) language proficiency.

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.. (4024) ..

**As time goes by - stability and variability of behavioral performance and ERP parameters during the Eriksen flanker task over time.** LARISSA LEIST, THOMAS SCHMIDT, NEILLOFAR FAMILY & DANIELA CZERNOCHOWSKI; *TU Kaiserslautern, Germany*

The ability to monitor our actions and re-adjust our cognitive system when necessary enables us to continually improve our performance. In this process, the ability to detect response conflict is thought to play a key role. Although time is a central aspect in optimizing performance, so far little is known about the time course of cognitive adjustments as participants continue to perform a task repeatedly. The temporal resolution of event-related potentials (ERPs) allows to disentangle cognitive processes during response preparation and following response execution. One ERP correlate in particular, the ERN, has been of interest lately as an index of response conflict detection immediately after an incorrect response. Notably, particularly large or small ERN amplitudes have been implicated as markers for clinical disorders (e.g. anxiety, depression), implying a trait-like individual characteristic which is remarkably stable over time.

Here, we investigated the extent to which performance and the underlying neuronal activity are modulated over time on task in a student population. Participants performed a modified flanker task in two sessions one week apart while EEG was recorded. On each of the 320 trials per session, a target arrow was presented in the middle of the screen flanked by a total of 8 arrows. In 50 % of all trials, target and flanking arrows pointed to the same or opposite directions (congruent vs. incongruent condition). After 40 trials participants were given a short break.

Behavioral performance was largely stable over time, but showed considerable individual differences, in particular in terms of response accuracy. Only subtle differences between sessions were apparent in ERN amplitudes, which gradually diminished over time. Notably, participants with high performance showed larger ERN amplitudes compared to their peers who committed more errors. Together, these results are in line with inter-individual differences, but intra-individual stability on error monitoring over time.

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## Poster Session IV

### S13, Wednesday, 10:40 – 12:00

.. (4301) ..

#### **Verbal mindreading is related to explicit but not implicit visual perspective-taking.**

AGATA ZŁOTOGÓRSKA-SUWIŃSKA & ADAM PUTKO; *Adam Mickiewicz University in Poznań, Poland*

The purpose of the study was to examine the relationship between the ability to attribute mental states and two measures of taking another person's visual perspective: implicit and explicit. According to the main hypothesis of the study, it was expected that the ability to understand the mental states of other people would be more strongly related to explicit Level-2 visual perspective-taking (Flavell et al., 1981), involving the understanding that the same object can be seen differently by two different persons. The study involved 60 adults aged 19 to 50 years who performed computerized tasks that measured the speed and correctness of judgments about another's or one's own visual perspective. In these tasks three factors were manipulated: the level of perspective (Level-1, Level-2), the type of perspective (Self, Other) and the consistency between the participant's and the other's perspectives (Consistent, Inconsistent). The total score on Strange Stories (Happé, 1994) was a measure of verbal mindreading. The main results showed the relationship between mindreading ability and Level-2 visual perspective-taking but only in 'Other' trials, which were a measure of explicit perspective-taking. The higher the ability to attribute mental states, the shorter were the response times in these types of trials of visual perspective-taking task. There was no similar connection between mindreading ability and implicit perspective-taking as measured by interference in 'Self' trials. The implications of the results for contemporary theories of mindreading and visual perspective-taking are discussed.

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.. (4302) ..

#### **Is far transfer a myth? Evidence from chess, music and working memory training.**

GIOVANNI SALA & FERNAND GOBET; *University of Liverpool, United Kingdom*

There is considerable evidence that experts in domains such as chess and music have better overall cognitive ability (e.g. intelligence or working memory [WM]) than the general population. Moreover, cognitive ability appears to be a predictor of music and chess mastery, especially in children. Several researchers have thus claimed that music training and chess training may be beneficial for children's and young adolescents' overall

cognitive ability and academic achievement. The rationale is that practice of chess and music requires WM. WM correlates with fluid intelligence, chess skill, and music skill. Thus, training chess and music skills enhances WM capacity and fluid intelligence, which, in turn, foster academic achievement.

We tested the above claims with three meta-analyses. Two meta-analyses (Sala & Gobet, 2016, 2017a) assessed the effect of chess and music instruction at enhancing children's and young adolescents' academic attainment (e.g., literacy and mathematics) and cognitive skills. A third meta-analysis (Sala & Gobet, 2017b) was carried out to evaluate the effects of WM training on typically developing children's academic achievement, fluid intelligence, and other cognitive skills.

The results showed small to medium overall effect sizes in all the three meta-analyses. However, the size of the effects was inversely related to the quality of the experimental design. Specifically, when the participants were randomly allocated to the groups and the experimental groups were compared to active control groups, the overall effect sizes were minimal or null. A fourth meta-analysis (Sala, Tatlidil & Gobet, submitted) with video game training supports these conclusions.

These outcomes show that the lack of generalization of skills acquired by training – i.e., far transfer – is a constant in human cognition. Consequently, the present results cast serious doubts upon the effectiveness of cognitive-training programs and recent educational practices that focus on teaching transferable skills.

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.. (4303) ..

#### **Egocentric bias across mental and non-mental representations.**

STEVEN SAMUEL<sup>1</sup>, EDWARD LEGG<sup>1</sup>, ROBERT LURZ<sup>2</sup> & NICOLA CLAYTON<sup>1</sup>; <sup>1</sup>*University of Cambridge, United Kingdom*; <sup>2</sup>*The City University of New York, Brooklyn College*

In the Sandbox Task (e.g. Sommerville, Bernstein & Meltzoff, 2013), participants indicate where a protagonist who has a false belief about the location of an object will look for that object in a trough filled with a substrate that conceals the hidden object's location. Previous findings that participants tend to indicate a location closer to where they themselves know the object to be located have been interpreted as evidence of egocentric bias when attributing mental states to others. We tested the assumption that such biases occur as a result of reasoning about mental states specifically. We found that participants showed more egocentric bias when reasoning from a protagonist's false belief than from their own memory, but found equivalent levels of bias when they were asked to indicate where a false film would depict the object as when they were



asked about a protagonist's false belief. Our findings suggest that that egocentric biases found in adult false belief tasks are more likely due to a general difficulty with reasoning about false representations than a specialised difficulty with reasoning about false mental states.  
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.. (4304) ..

**Effects of emotions induced by failures in the Simon task.** KAZUSHIGE WADA & YUUKI ASHITAKA; *West Japan Railway Company, Japan*

We have been investigating human errors and especially the mechanisms of chains of errors, which is defined as problems or errors causing other problems or errors. In this study, we investigated whether regrets evoked by failures caused cognitive errors. Participants (N = 26) conducted the Simon task in 8 blocks of 74-85 trials. Participants were requested to press keys using both the hands and the feet as quickly and precisely as possible. They were also instructed to complete more than 80 trials in a block within 3 minutes to obtain the basic score. During each block, feedback on scores and comments about the basic score were presented to the participants. Feedback in the first block was set to have a "failure" message (the score was 78 trials). Feedback in the second block was set to have a "success" message (the score was 82 trials). Feedback after the third block consisted of two conditions: a success condition, in which feedback scores were always above 80 trials and a comment about success; or a failure condition in which feedback scores were always below 80 trials and a comment about failure that was designed to induce regret. Results of 3rd to the 8th block indicated that regret scores in the failure condition were significantly higher than those in the success condition. Analysis of RT difference between each 4th to 8th block and the 3rd block showed that RTs in the success condition were shorter than those in the failure condition, although only RT difference in 7th block was marginally significant. However, error rates between each 4th to 8th block and the 3rd block in both conditions were not significantly different. These results suggest that regrets inhibited performance improvements, especially those related to the speed of processing cognitive tasks.  
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.. (4305) ..

**The role of spatial ability and working memory in multitasking.** VEIT KUBIK<sup>1,2</sup>, MARIUS ZIMMERMANN<sup>1</sup>, FABIO DEL MISSIER<sup>3</sup>, TORSTEN SCHUBERT<sup>4</sup>, ANDREA FRICK<sup>5</sup> & TIMO MÄNTYLÄ<sup>1</sup>; <sup>1</sup>*Stockholm University, Stockholm, Sweden*; <sup>2</sup>*Humboldt-Universität zu Berlin, Berlin School of Mind, Germany*; <sup>3</sup>*University of Trieste, Trieste, Italy*; <sup>4</sup>*Martin-Luther-Universität Halle-Wittenberg, Halle, Germany*; <sup>5</sup>*University of Fribourg, Fribourg, Switzerland*

Multitasking involves monitoring and executing multiple tasks within a relatively short time window, with high demands on temporal coordination. Previous research showed that spatial ability uniquely contributes to multitask performance, and suggested that spatial ability can alleviate the involved executive-control demands. In this study, we tested a central boundary condition of this spatiotemporal hypothesis by contrasting dual- vs. multitasking in a timer task, in which participants monitored 2 versus 4 digital timers running at different rates. To the extent that multitasking requires more temporal coordination than dual-tasking, we expected spatial ability to be more involved in multiple-task performance. To test the generality of the spatiotemporal hypothesis, we eliminated any spatial cues of the subtasks, and we also manipulated the characteristics (number, letters, vs. gauges) and direction (backward vs. forward) of the timer-subtasks. In two experiments, participants completed various multitask scenarios, along with measures of spatial ability, spatial updating, and measures of both spatial and verbal working memory. Preliminary results showed that spatial ability incrementally explained multitask, but not dual-task, performance independent of the nature of the subtasks. In light of these findings, we discuss the role of spatial ability and working memory in multitask performance.

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.. (4306) ..

**Can mechanistic explanation make people with low level of knowledge see their ignorance? Exploring Dunning-Kruger effect in the domain of global climate change.** JAN URBAN<sup>1,2</sup> & MIROSLAV HAVRANEK<sup>2</sup>; <sup>1</sup>*Masaryk University, Czech Republic*; <sup>2</sup>*Charles University, Czech Republic*

Background

Dunning-Kruger effect is a well-established bias which makes people low in some ability, such as knowledge, overestimate their competence due to lack of meta-cognitive skills that would allow them to see their ignorance (Kruger & Dunning, 1999). We hypothesize that the size of the Dunning-Kruger effect in the domain of global climate change knowledge can be reduced using mechan-

istic explanation of GCC, which is known to change peoples' beliefs and attitudes to GCC (Ranney & Clark, 2016).

#### Method

We conduct two studies. Study 1 is a correlational study (N = 150) on an internet panel which focused on the relationship between subjective and objective mechanistic knowledge of GCC. Objective knowledge is measured using 30-item Rash-calibrated scale of objective mechanistic knowledge based on Ranney and Clark's (2016) model of mechanistic knowledge. Subjective knowledge is measured using estimated percentile of knowledge (Kruger & Dunning, 1999). Study (N = 300) is an online within-subjects experiment. Participants in the experimental group view a 3-minut video that provides mechanistic explanation of GCC, whereas participants in the control group view unrelated video about popularization of science. Subjective and objective knowledge of GCC is then assessed using the same measures as in Study 1.

#### Results

Results of study 1 show Dunning-Kruger effect in GCC domain, namely tendency of people with low level of mechanistic knowledge to overestimate their level of knowledge. Study 2 corroborates these findings and shows that the size of the bias due to Dunning-Kruger effect is reduced through provision of mechanistic information.

#### Discussion

Dunning-Kruger effect makes people with low level of mechanistic knowledge to see themselves as more knowledgeable. However, provision mechanistic explanation of GCC can reduce this bias.

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.. (4307) ..

**lab.js: A graphical interface for creating, running and sharing browser-based experiments.** FELIX HENNINGER<sup>1,2,3</sup>, ULF K. MERTENS<sup>4</sup>, YURY SHEVCHENKO<sup>2</sup> & BENJAMIN E. HILBIG<sup>1,3</sup>, <sup>1</sup>*University of Koblenz-Landau, Germany*; <sup>2</sup>*University of Mannheim, Germany*; <sup>3</sup>*Max Planck Institute for Research on Collective Goods, Bonn, Germany*; <sup>4</sup>*University of Heidelberg, Germany*

Web-based data collection is increasingly popular in both experimental and survey-based research. While dedicated software for constructing laboratory-based research is commonplace, researchers looking to implement their studies in the browser have heretofore manually constructed their studies' content and logic using code. We introduce lab.js, a free, open-source experiment builder and JavaScript library designed to vastly simplify the realization of browser-based experiments. Using our tool, researchers with a basic knowledge of HTML and CSS can construct studies through a drag-and-drop interface familiar to ex-

perimental researchers, without manual programming. By adding JavaScript code, studies can be customized further and adapted to even complex requirements. Data collection can take place in the laboratory and across the web, and our tool will bundle all necessary parts for a simple installation on any server. Studies can also be shared, archived, re-used and adapted, enabling effortless, transparent replications, and cumulative science. The software, code, and extensive documentation are available from <https://felixhenninger.github.io/lab.js/> Email: [mailbox@felixhenninger.com](mailto:mailbox@felixhenninger.com)

.. (4308) ..

**Physiological arousal influences implicit evaluative conditioning effects.** ROBERT BALAS<sup>1</sup>, JOANNA SWEKLEJ<sup>2</sup>, GRZEGORZ POCHWATKO<sup>1</sup> & JUSTYNA ŚWIDRAK<sup>1</sup>; <sup>1</sup>*Polish Academy of Sciences, Warsaw, Poland*; <sup>2</sup>*University of Social Sciences and Humanities, Warsaw, Poland*

Evaluative conditioning (EC) as a mechanism of attitude acquisition is defined as a change in evaluation of initially neutral object (CS) that can be attributed to its repeated pairing with affectively laden stimulus (US). Although the functional properties of EC as well as its theoretical interpretations had already received a considerable attention it is still an open question whether EC effect is mediated by arousal levels associated with US. Our research builds on Gawronski and Mitchell (2014) who showed a simultaneous conditioning of CS valence and arousal. Since they have used a declarative measures of arousal, we extend their findings by showing a positive relation between physiological arousal (the strength of GSR and EMG responses) and EC effect. Also, we show a dissociation between explicit and implicit EC measures and physiological arousal in that physiological arousal is more strongly related to implicit rather than explicit evaluations and declarative arousal is associated with explicit, but not implicit, evaluations. Finally, our data show that US revaluation effect is fully moderated by declarative arousal as reflected in successful evaluative change on explicit, but not, implicit measures. This provides support for dual-process models of affective learning over single-process accounts. Those findings feed the current controversies surrounding the mechanisms of attitude acquisition.

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.. (4309) ..

**The Perils of Learning Style Assessment.** CAROLINA KUEPPER-TETZEL; *University of Dundee, United Kingdom*

Learning styles are omnipresent in education even though there is no empirical evidence justifying their application. Studies that have used proper methodology conclude that there is no benefit of knowing and using an assessed learning preference. However, potential dangers of classifying students into a certain learning style have not yet been directly examined. In authentic educational settings, when learning styles are assessed, students are usually told their learning style. The question that arises is whether the mere knowledge of a learning style alters the way students decide to process information. Students may look longer at information tailored to their learning style and discredit information at odds with it. In the long run, this can hurt their understanding of the to-be-learned material and demotivate them to study if the material is not given in the preferred way. In this experiment, participants' learning style was assessed using a questionnaire. Afterwards participants were either informed that they were visual learners, verbal learners, or that they had no specific learning style (control group). Subsequently, participants worked through a slideshow that contained alternating verbal and visual slides. Slide content and slide type (visual vs verbal) was counterbalanced by starting one slideshow with a visual slide and another with a verbal slide. Time spent on each slide was measured. The results are in line with the hypothesis: Participants who were informed that they were visual learners spent more time on visual slides than on verbal slides; for participants who were told they were verbal learners the opposite pattern occurred. Interestingly, if the slideshow started with a slide that was inconsistent with the assessed learning style, participants decided to spend less time on the entire slideshow. Thus, learning style assessment comes with perils that can harm student learning. Practical implications for students and educational institutions are discussed.

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## Poster Session IV S14, Wednesday, 10:40 – 12:00

.. (4401) ..

**A causal role of face and hand motor systems in processing abstract emotional nouns – results from voxel based lesion symptom mappings on patients with focal brain lesions.** FELIX R DREYER<sup>1</sup>, DIETMAR FREY<sup>2</sup>, THOMAS PICHT<sup>2</sup> & FRIEDEMANN PULVERMÜLLER<sup>1,3</sup>; <sup>1</sup>*Freie Universität Berlin*; <sup>2</sup>*Charité Hospital Berlin*; <sup>3</sup>*Berlin School of Mind and Brain*

Previous fMRI results by Moseley et al. (2012) provided evidence that the motor system is not only involved in the processing of concrete words, but also activates when abstract emotional words, like "love" or "hate" are being processed. Recently, single case reports of neurological patients by Dreyer et al. (2015) indicated that this role might even be of causal nature. To extend on this issue, the current approach investigated semantic processing in a cohort of 36 tumor patients with left hemispheric, focal peri- and extrasyllabic lesions, using a speeded lexical decision task which applied words from different semantic categories as target stimuli that were matched for psycholinguistic properties on a lexical and sub-lexical level. Categories included concrete face-action related Food nouns (e.g. "apple"), hand-action related Tool nouns (e.g. "hammer"), non-action related Animal nouns (e.g. "dog"), and abstract emotional nouns, which had neither transparent action related nor sensory semantics, as confirmed by semantic ratings. Data were analyzed using a non-parametric voxel based lesion symptom mapping approach to compare performance between patients with and without a lesion for every voxel. Results indicate a perisylvian cluster to be most prominent for Animal nouns, whereas ventral pre- and postcentral (Brodmann Areas 3, 4 and 6) in addition to temporal areas were related to performance for Food nouns and dorsal somatosensory, parietal and temporal voxels showed effects for Tool processing. For Abstract Emotional nouns clusters spanning not only over posterior and medial temporal, but also covering dorsal and ventral precentral areas (BA 6) were revealed in analyses of both, response time and accuracy. These results point to a causal, rather than a mere epiphenomenal role of primary and pre-motor areas for the processing of not only concrete action related-, but also for abstract emotional nouns.

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.. (4402) ..

**Perceptual Richness and Its Role in Free and Cued Recall.** MILICA POPOVIĆ STIJAČIĆ<sup>1</sup> & DUŠICA FILIPOVIĆ ĐURĐEVIĆ<sup>2,1,3</sup>; <sup>1</sup>*Laboratory for Experimental Psychology, University of Novi Sad, Serbia*; <sup>2</sup>*Department of Psychology, Faculty of Philosophy, University of Novi Sad, Serbia*; <sup>3</sup>*Laboratory for Experimental Psychology, University of Belgrade, Serbia*

This research aimed to clarify the role of the perceptual richness in the recall. Perceptual richness is operationalized as the number of sensory modalities through which an object can be perceptually experienced, and is based on per-modality concreteness ratings (Connell & Lynott, 2009; Filipović Đurđević, Popović Stijačić & Karapandžić, 2016). Our previous research revealed that several measures of perceptual richness predict processing latencies in a visual lexical decision task over and above traditional concreteness. Furthermore, words denoting objects that could be experienced with many sensory modalities (frog) were better recalled in paired associate learning (PAL) task compared to those that could be experienced with a few modalities (rainbow), and compared to abstract words (Popović Stijačić & Filipović Đurđević, 2015). Here, we set two goals. On the one hand, we aimed to extend these findings by testing the effect of perceptual richness in the free recall task. On the other hand, we tested the same effect in PAL task with a new set of stimuli that are matched for additional variables the effects of which have been shown to have important theoretical consequences: relatedness of word pairs, context availability, and emotional valence. In the free recall task abstract words were outperformed by the many-modalities words, but not with few-modalities words (in the postponed recall). The same was observed in the cued recall task, both for related and unrelated word pairs. Having in mind the stimuli matching, the results from the second experiment rule out hypotheses of the context availability (Schwanenflugel, Akin & Luh, 1992), emotional valence (Kousta, Vinson & Vigliocco, 2009) and relational-distinctiveness (Marschark & Hunt, 1989). Taken together, our findings suggest that additional perceptual codes improve recall. As such, they fit with predictions of multiple coding theories, such as Perceptual Symbol Theory (Barsalou, 1999) and extended Dual-coding Theory (Paivio, 2006).

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.. (4403) ..

**A fNIRS study on the role of rTPJ in self-other distinction during face-to-face interaction.** LARA BARDI<sup>1</sup>, ARIANNA ZANATTA<sup>1</sup>, ROMA SIUGZDAITE<sup>1</sup>, OLIVER GENSCHOW<sup>2</sup> & MARCEL BRASS<sup>1</sup>; <sup>1</sup>*University of Gent, Belgium*; <sup>2</sup>*University of Cologne, Germany*

**Background.** Research in social neuroscience has shown that observing human behavior activates brain areas that are also involved in the execution of the observed movements. Performing an action while concurrently observing an incongruent action leads to response interference. The right temporo-parietal junction (rTPJ) has been suggested to play a crucial role in self-other distinction, and specifically in detecting a mismatch between our own motor intention and the externally triggered motor representation (visual feedback). However, studies based on computer tasks lack an important aspect of our social world, namely the interactive part. In the present study, we used functional near-infrared spectroscopy (fNIRS) to investigate the role of the rTPJ in self-other distinction during face-to-face interaction.

**Method.** Twenty-three participants were engaged in an interactive task with a confederate, while the blood-oxygen-level-dependent (BOLD) response was measured with fNIRS. There were two main task conditions: imitation and counter-imitation. In the imitation condition, the participant performed a gesture and the confederate imitated him/her. In the counter-imitation condition, the confederate responded with a different gesture. In different blocks, we used meaningful and meaningless gestures. Participants were told that the confederate was free to choose which movement to perform in each trial.

**Results.** Higher activation in the rTPJ region was found in the counter-imitation condition as compared to the imitation condition. Moreover, higher activation was present for meaningful as compared to meaningless gestures.

**Discussion.** Results support the hypothesis that the rTPJ is involved in detecting a mismatch between executed and the observed actions. Greater activation during the execution-observation of meaningful vs. meaningless gestures is in line with the fact that the rTPJ is also involved in mentalizing. More importantly, our study supports the idea that fNIRS is a valuable tool to study imitation during real interactions.

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.. (4404) ..

**Doing it the Pilot way: Simon Effects for egocentric and allocentric reference points.** PAMELA BAESS & CHRISTINA BERMEITINGER; *University of Hildesheim, Germany*

Previous studies have shown that multiple spatial codes can be formed in a Simon Task. However, these Simon effects due to multiple reference frames were only present when an external object was given next to the target. In a series of experiments, we applied a version of a Simon Task using ecologically significant stimuli, namely stick-figure manikins. The manikins were presented on either side of the screen (egocentric reference frame). Moreover, the manikins were holding a ball in either hand (allocentric reference frame). In contrast to previous research, both reference frames were present at the same time and most importantly, did not require an external reference point. Further, the amount of manikins on the display was varied; presenting the manikin either alone (1-manikin condition) or within a set of nine identical manikins (9-manikin condition). Consistently across all experiments, spatial codes were formed on both, egocentric and allocentric reference frame. However, the size of the Simon effect varied: larger Simon effects were obtained for the spatial codes based on the egocentric perspective in the 1-manikin condition compared to the 9-manikin condition. No such effect was observed for the spatial codes based on the allocentric reference frame. These results provide new perspectives for linking social and spatial cognition.

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.. (4405) ..

**Vertical position and the processing of social exclusion: Electrophysiological evidence for an expectancy model.** KATHARINA SCHUCK, MICHAEL NIEDEGGEN & RUDOLF KERSCHREITER; *FU Berlin, Germany*

Previous research has shown that the link of vertical position and self-assigned social power can affect the processing of social exclusion, specifically the subjective expectancy of social participation (associated with the P3 amplitude). Evidence suggests that a lower vertical position relative to others induces a 'preparedness for exclusion', as it goes along with reduced P3 amplitudes and lower self-reported threat of social needs. Previously, these effects of exclusion and moderation of verticality were found in repeated-measure designs including a transition to exclusion. Here, a single cyberball game of exclusion (high vs. low partial exclusion) was played with the participant represented by an icon in a superior vs. inferior vertical position relative to the co-players. The present study replicated the expectancy P3 effect and corresponding

need threat self reports for exclusion in a between-subjects design. P3 amplitudes were lower and social needs less threatened for participants represented in the inferior vertical position. Post-hoc split-half analyses detected a decrease in P3 amplitudes over the course of the experimental run for participants in the inferior position only. The results indicate that verticality impacts the time course of subjective expectancy recalibration and support the idea that 'being low prepares for being neglected'.

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**Embodied Cognition in Multitasking: Increased Hand-specific Task Shielding when Stimuli are Presented Near the Hand.** RICO FISCHER<sup>1</sup> & ROMAN LIEPELT<sup>2</sup>; <sup>1</sup>*University of Greifswald, Germany*; <sup>2</sup>*German Sport University Cologne*

The proximity of hand position alters the processing of visual stimuli. Stimuli presented close (proximal) to hands receive an enhanced allocation of visual attention compared to stimuli presented far (distal) from hands. In the present dual-task study we studied the consequences of this preferential processing when two stimuli (S1 and S2) were presented together and were assigned to specific response hands (R1 and R2) located proximal (at the monitor) versus distal (in the lap) to the stimuli. In Experiment 1, we tested whether stimulus-hand proximity affected T1 shielding by measuring the extent of between-task interference. Results showed that stimulus-hand proximity reduced the amount of between-task interference (increased T1 shielding) compared to the distal stimulus-hand condition. This suggests a facilitated processing of stimuli presented close to an individual response hand (single attentional focus) but is inconsistent with the assumption of a generally increased attentional processing benefit for multiple stimuli within hand space. In Experiment 2, the efficiency of shifting processing between tasks (T1-T2 shifting) was not affected by stimulus-hand proximity. Instead, a slight performance trade-off in the proximal condition supports previous assumptions of generally more elaborate stimulus processing. Together these findings demonstrate that stimulus-hand proximity affects the quality of multiple task performance, which is discussed in the context of both, basic and applied cognitive research.

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.. (4407) ..

**Age-related differences in perception-action interaction when using tools.** CHRISTINE SUTTER & OLIVER SACK; *German Police University, Germany*

When using tools with sensorimotor transformation (e.g., a computer mouse, a steering wheel),

visual and haptic information often does not correspond. The integration of competing information from different sensory modalities challenges the human information processing system. With aging, visual action control becomes increasingly relevant, and this attenuates the impact of body-related action effects. In the present study, we investigate age-related differences in perception-action interaction by focussing on the early and late working age. Young and middle-aged participants (26-38 and 53-67 years of age, respectively) moved a pen on a covered digitizer tablet while a gain varied the relation between hand and cursor amplitude (phase 1). In phase 2, participants replicated the hand amplitude (intra-modal) or the cursor amplitude (intermodal) without visual feedback. In this two-phase motor replication task, systematic deviations in accuracy of the open-loop controlled replication in phase 2 are interpreted as after-effects arising from sensory information in phase 1 (closed-loop controlled). And these after-effects are what we found: when the not-to-be-replicated amplitude was longer (shorter) than the to-be-replicated amplitude, replications significantly overshot (undershot). Furthermore, after-effects in intra-modal as well as intermodal replications were smaller for young participants than for middle-aged participants. The results show that the onset of age-related changes in perception-action control can be clearly located in middle adulthood. In conclusion, action-effect control plays an important role in understanding the constraints of the acquisition and application of tool transformations in the middle and late working population.

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## Poster Session IV

S15, Wednesday, 10:40 – 12:00

.. (4501) ..

### **The influence of initial experience on subsequent risk-taking behavior.**

ESZTER TÓTH-FÁBER<sup>1</sup>, ANDREA KÓBOR<sup>2</sup>, ÁDÁM TAKÁCS<sup>3,1</sup>, ZSÓFIA KARDOS<sup>4,5</sup>, KAROLINA JANACSEK<sup>1,6</sup>, NOÉMI ÉLTETŐ<sup>1</sup>, VALÉRIA CSÉPE<sup>2,5</sup> & DEZSÓ NÉMETH<sup>1,6</sup>;  
<sup>1</sup>Institute of Psychology, Eötvös Loránd University, Budapest, Hungary; <sup>2</sup>Brain Imaging Centre, Research Centre for Natural Sciences, Hungarian Academy of Sciences, Budapest, Hungary; <sup>3</sup>Institute of Neuroscience and Psychology, University of Glasgow, Glasgow, United Kingdom; <sup>4</sup>Institute of Cognitive Neuroscience and Psychology, Research Centre for Natural Sciences, Hungarian Academy of Sciences, Budapest, Hungary;

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#### Background

In prior studies, the influence of primarily encountered information and initial experience have been examined regarding perceptual and memory processes. However, there are still questions about how these effects manifest during decision-making. Therefore, in the present two studies, we aimed to examine the effect of initial experience, more precisely, initial luckiness or unluckiness on later behavior in a sequential risk-taking task.

#### Method

We used an ecologically valid decision making task, the Balloon Analogue Risk Task (BART), which mimics interdependent decisions with limited information on riskiness. We conducted two experiments with healthy young adults.

#### Results

According to the results of Experiment 1, participants experiencing mostly positive feedback during the first few trials tended to explore the task more and showed higher risk-taking behavior than participants experiencing mostly negative feedback. However, the design of Experiment 1 did not enable to study whether lucky or unlucky experience had a stronger influence on later risk-taking behavior. Therefore, in Experiment 2, we applied a third condition as well, where participants experienced neutral feedback in the first fourth of the trials. The results of Experiment 2 showed that participants who predominantly received negative initial feedback showed decreased subsequent risk taking during the first half of the task as opposed to participants who received positive or neutral initial experience. However, this effect was limited as participants have successfully overcome their initial experiences and showed increased risk-taking behavior during the second half of the task.

#### Discussion

In our two studies, we found evidence for a “beginner’s bad luck” phenomenon on risk-taking behavior. These results could help improve decision-making models and contribute to the more precise testing of sequential risk-taking.

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.. (4502) ..

### **Error Analysis for Raven’s Advanced Matrices in the Context of Reasoning Verbalization.**

DOMINIKA PANKOW, MAŁGORZATA KISIELEWSKA & MARIUSZ URBAŃSKI; Adam Mickiewicz University in Poznań, Poland

#### Background

We address the problem of error analysis in Raven's Advanced Matrices Test (APM). While the number of correct answers indicates a level of intelligence, the analysis of errors may lead to more information on test taker's cognitive processes. In their paper "Error Patterns on the Raven's Standard Progressive Matrices Test", Kunda et al. propose a new method for classifying errors in Raven's Standard Progressive Matrices test. We applied their method to a set of APM problems.

#### Method

We run a pilot study on a group of 20 subjects. They were presented with VA-APM - a shortened version of APM consisting of equal number of tasks invoking both visual and analytical strategy. Group A took the test in standard setting and group B was asked to give verbal description of their reasoning processes while solving the tasks.

#### Results

Seeing as verbal reporting should influence the strategy used during the task solving, we expected to see differences in error patterns between the two groups. As verbal reporting group was forced to use the analytical strategy while solving the tasks, we expected to see less errors made by them for analytical stimuli. Some results surprisingly showed contrary inclinations. When subjects chose wrong answer most similar to the correct one, verbal protocol group made 20% more errors than the standard one. However, they made less errors of simpler kind.

#### Discussion

Our results suggest that verbalizing may influence kinds of errors the subjects are most likely to make. It helps to avoid simple mistakes, but increases chances of committing more complex ones. Transcriptions allowed us to hypothesize that working memory overload, caused by additional task of verbalization, may have been partially responsible. It inspired us to run a more complex version of the study, this time controlling for executive functions performance and anxiety levels.

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.. (4503) ..

**The effects of response cardinality and consensuality on confidence judgments in syllogistic reasoning.** IGOR BAJŠANSKI & VALNEA ŽAUHAR; *University of Rijeka, Croatia*

According to the Self-consistency model of subjective confidence (Koriat, 2012), confidence judgments for two-alternative forced-choice questions are related to the consensuality of the answer (the proportion of participants who choose the answer) rather than to its accuracy. Jackson (2016) extended the Self-consistency model to open-ended questions and proposed that higher response cardinality (the number of unique response options) should re-

duce confidence. We tested the assumptions of the Self-consistency model using the syllogistic problems. Participants solved 64 syllogistic problems. All logically possible pairs of premises regarding mood of premises and syllogism figure were included. Participants were asked to generate a conclusion to each problem and to make confidence judgments. The relationships between accuracy, confidence judgments, consensuality and cardinality were analysed. The obtained results strongly supported the predictions of the Self-consistency model. First, confidence was not related to response accuracy. Second, confidence was negatively correlated with response cardinality. Problems with higher number of unique responses were associated with lower confidence ratings. Third, confidence was positively correlated with response consensuality. Answers endorsed by large proportion of participants were given with high confidence, regardless of their accuracy. The obtained results clearly point to the conclusion that confidence judgments do not monitor the actual reasoning performance, but that they rely on consistency (indicated by the consensuality of the response) and response cardinality.

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.. (4504) ..

**Facial ERP to touch, trust and betrayal: From Midas Touch to Judas' Kiss.** MICHIEL MARTEN SPAPE<sup>1</sup>, VILLE HARJUNEN<sup>2,3</sup> & NIKLAS RAVAJA<sup>2,3</sup>; <sup>1</sup>*Liverpool Hope University, United Kingdom*; <sup>2</sup>*Aalto University, Finland*; <sup>3</sup>*University of Helsinki, Finland*

Social touch is a critical requirement for successful emotional development. This may explain why, even in later life, a seemingly trivial tap on the shoulder has been shown to have remarkable consequences, including tips in restaurants, appreciation for libraries, and free rides from bus drivers. Despite this, it remains unclear whether touch causes positive affect in general, or positive attitudes towards a person. A social version of the Iowa Gambling Task was used to cause participants to associate trustworthiness, defined as high likelihood of rewarding outcomes, and social touch, with four different faces. Contrary to predictions, trust was not learned faster in touch than non-touch conditions. However, after a sudden change in contingencies, touch was found to result in a failure to stop trusting the previously advantageous, now disadvantageous, choice. Following the decision-making game, ERPs to the faces showed distinct effects of touch, while trust and emotional evaluation of faces were found to minimally affect ERPs. Indeed, effects of touch seemed most persistent when they concerned a failure in trust. We discuss the findings and conclude that touch does not neces-

sarily lead to positive affective outcomes, and that when touch is related with a betrayal, it may well turn from Midas Touch to Judas' Kiss.

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.. (4505) ..

**The Influence of Time Pressure and Cognitive Load on Moral Decision Making.** BARTŁOMIEJ KUCHARZYK & EDWARD NĘCKA; *Jagiellonian University, Poland*

As Joshua Green's dual process theory of moral judgment suggests, people use both emotions and reasoning while solving moral dilemmas. Emotions tend to lead them to intuitive, deontic decisions whereas reasoning supports calculative, utilitarian decisions. If so, the latter decisions should be more closely related to the basic features of human cognitive apparatus and more sensitive to the factors which influence its work.

Time pressure and cognitive load will be presented as possible factors affecting cognitive processes relevant in making moral decisions.

Two hypotheses are stated. First, both investigated factors (time pressure and cognitive load) increase the tendency to make deontic rather than utilitarian moral decisions. Second, cognitive load increases decision time of utilitarian decisions but not of deontic ones.

All participants will play a computer game designed to introduce two variants of the probably most studied moral dilemma i.e. Trolley Problem – Footbridge Dilemma and Switch Dilemma. In a between-subjects experimental design time pressure will be applied within the game by reducing the time limit for solving the dilemmas (experimental group #1) and cognitive load will be applied within the dual-task paradigm – participants will be asked to maintain sets of ciphers in the working memory while playing the game (experimental group #2).

The proportions of deontic and utilitarian decisions in the experimental groups on the one side and the control group on the other, as well as the respective decision times, will be compared and discussed.

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.. (4506) ..

**The role of context and visual similarity in function and manipulation knowledge: an fMRI study.** CYNTHIA COLLETTE<sup>1</sup>, CATARINA TAIBO<sup>2</sup>, ISABELLE BONNOTTE<sup>1</sup>, PAULO MARQUES<sup>3</sup>, SAMPAIO ADRIANA<sup>2</sup> & ANGELA BAROLO<sup>1</sup>; <sup>1</sup>*Univ. Lille, CNRS, CHU Lille, UMR 9193 - SCALab - Sciences Cognitives et Sciences Affectives, Lille, France*; <sup>2</sup>*Neuropsychophysiology Lab, CIPsi, School of Psychology, University of Minho, Campus Gualtar, Braga,*

*Portugal*; <sup>3</sup>*Life and Health Sciences Research Institute (ICVS), School of Health Sciences, University of Minho, Campus Gualtar, Braga, Portugal, ICVS/3B's*

**Background:** Previous neuroimaging studies showed that manipulation knowledge compared to function knowledge activate a left frontoparietal network. A couple of studies showed that function knowledge compared to manipulation knowledge did not reveal any specific activation (Kellenbach et al., 2003; Boronat et al., 2005) whereas in one study it activated the inferotemporal cortex (Canessa et al., 2008). However, objects sharing the same manner of manipulation tend to be visually similar (e.g. watering can-teapot, Collette et al., 2016) while objects sharing the same function usually belong to the same context (e.g. dust collector-vacuum cleaner, Boronat et al., 2005). In the present study, we investigated function and manipulation knowledge when controlling for context and visual similarity respectively.

**Method:** In an fMRI block design paradigm, 15 healthy young adults had to make similarity judgments according to object manipulation, object function, visual similarity and context of a series of pairs of line drawing pictures of manipulable objects.

**Results:** Direct comparison of manipulation knowledge to visual similarity showed activation in the supramarginal gyrus and the superior frontal gyrus. When function knowledge was compared to context no cluster survived. The key comparison between manipulation knowledge controlled for visual similarity and function knowledge for context, showed activation in the left middle occipital and middle temporal gyrus for manipulation knowledge. No activation was found in the reverse comparison.

**Discussion:** Our results suggest the manipulation knowledge relies on the integration of hand postures (supramarginal gyrus) with an abstract representation of the object eliciting the motor simulation of its use (middle temporal gyrus, Lausberg et al. 2005). Function similarity judgments activate a distributed neural network based on object features (e.g., its context) that are not explicitly triggered by function knowledge. In this vein, function knowledge can be considered as the sum of a highly integrated representation of objects features. Email: cynthia.collette@hotmail.fr

.. (4507) ..

**Testing the cognitive, expectancy account of the size-weight illusion; Comparison with a novel weight illusion.** RACHAEL GOLDSMITH, ELIZABETH SACCONE & PHILIPPE CHOUINARD; *La Trobe University, Bendigo, Australia*

**Background**

The smaller of two objects typically feels heav-



ier than the larger one, even when the objects have equal mass (the size-weight illusion). One potential explanation for this robust finding is a cognitive, expectancy account. This account proposes that the illusion is driven by a violation of the expectation, acquired over a lifetime, that larger objects are typically heavier. The current study tested the expectancy account using judgement of liquid volume, which should produce a similar, expectation-based illusion. Specifically, we hypothesised that a lesser liquid volume would be perceived as heavier than a greater liquid volume of equal mass (the milk bottle illusion).

#### Methods

In Experiment 1, stimuli were two 500ml bottles, containing either 500ml or 250ml milk. A lead weight was added to the 250ml liquid such that the bottles had equal mass. Participants lifted each bottle 20 times using a string, and provided absolute magnitude estimates following each lift. Grip and load forces were also obtained for every trial. Experiment 2 was a traditional size-weight paradigm, in which participants lifted differently sized, but equally weighted bottles. Procedures were identical to Experiment 1.

#### Results

Experiment 1 showed whether expectations of relative volume weight resulted in a new weight illusion. For both experiments, grip and load force data demonstrated how sensorimotor processes adapt as the stimuli were experienced across trials. These data were compared to subjective weight judgements, indicating how the perceptual and motor systems each experience weight. Effect sizes were compared across experiments to determine whether the milk bottle illusion is of comparable strength to the size-weight illusion.

#### Discussion

This study has investigated the expectancy account of weight illusions and weight perception more generally by testing a novel weight illusion. Comparing Experiments 1 and 2 demonstrates whether or not a cognitive expectancy mechanism entirely explains the traditional size-weight illusion.

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functional and stable characteristics according to their experience-based long-term representations; the dorso-dorsal pathway (DDP) processes object structural and variable features.

Several studies investigated the cooperation between the two pathways when people face with traditional objects; none, however, has studied responses' mechanisms in condition of ambiguity rising from perceptual and semantic mismatches. Investigating such ambiguity would help in understanding the process of tool generalization, e.g. clarifying the role of different objects' properties and the involvement of the two pathways.

To this aim we measured time-related variables while reacting to the vision of objects, presented both in their usual and unusual – i.e., structurally modified, but still functionally recognizable – version.

74 participants judged if an object presented on a computer screen was related to eating/drinking by releasing one of two lateralized keys to grasp a power or a precision device. Releasing and grasping times were recorded.

A significant 3-way interaction evidenced slower times when the keys were released to grip the power device to the appearance of power objects.

A 2-way interaction showed a spatial affordance effect (faster grasping time when object's handle was oriented toward the responding hand and slower time for the opposite configuration) for unusual objects.

Results help understanding how the two pathways solve objects ambiguity. During the object's coding phase, i.e. before the key release, the VDP takes control: the releasing times increase when the correspondence between object and device occurs and functional stable representations are recalled by the slow VDP. In the second (motor) grasping phase, a spatial affordance effect emerges for uncomfortable objects only, suggesting the involvement of the DDP (elaborating variable affordances such as orientation) in conditions of structural novelty.

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.. (4509) ..

**The negotiation between the ventro-dorsal and dorso-dorsal streams when facing unusual versions of familiar objects: the mismatch between structural and semantic features.** IRENE SCIULLI, GIOVANNI OTTOBONI & ALESSIA TESARI; *University of Bologna, Italy*

Object interaction requires the complementary computation by two anatomo-functional mechanisms constituting the dorsal systems for action: the ventro-dorsal pathway (VDP) processes object

**Motor experience and its impact on cognitive flexibility.** LOUISE MARY O'REGAN<sup>1</sup>, MICHIEL SPAPÉ<sup>2</sup> & DEBORAH SERRIEN<sup>1</sup>; <sup>1</sup>*University of Nottingham, United Kingdom*; <sup>2</sup>*Liverpool Hope University, United Kingdom*

Everyday behaviour such as clapping to the beat of a song demonstrates the automaticity of timed responses to stimuli. Common experimental setups to study the synchronisation of actions to external signals such as tones are finger-tapping tasks. Typically taps precede tones when the pacing signal

is predictable, resulting in an anticipatory asynchrony. However, individual differences markedly influence the ability to time events. The current experiment investigated motor timing abilities in left- and right-handers during regular and irregular pacing sequences. Participants were required to tap in synchrony with regular and irregular (subliminal or supraliminal) presented tones. The main measurement included the synchronisation error. The results showed that taps preceded tones during regular and irregular pacing with subliminal time perturbations whereas irregular pacing with supraliminal time perturbations generated positive tap-tone asynchronies. Furthermore, left- and right-handers did not differ for the regular and irregular subliminal conditions whereas the left-handers showed a smaller tap-tone asynchrony than the right-handers for the irregular supraliminal conditions. Our data show that handedness guides motor timing abilities in situations when cognitive flexibility is required. Overall, the findings highlight that individual factors play a steering role in how one experiences time, which accordingly impacts on cognition and behaviour.

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.. (4510) ..

**The influence of action-outcome contingency on motivation to act.** TEGAN PENTON<sup>1</sup>, CAROLINE CATMUR<sup>1</sup> & GEOFF BIRD<sup>1,2</sup>; <sup>1</sup>king's college london, United Kingdom; <sup>2</sup>University of Oxford, United Kingdom

The sense of agency is defined as one's sense of control over one's actions and their consequences (Jeannerod, 2003). A number of cues can increase the sense of agency, with contingency of an outcome on action (i.e. the objective relationship between action and outcome) often being considered one of the most accurate. In addition to this, recent evidence has suggested that increased agency over an event can lead to greater motivation to cause an event to reoccur by repeating the action (motivation from control). This was established in a study manipulating the probability of an outcome occurring following an action (Karsh & Eitam, 2015), however the contribution of contingency was not manipulated. The current study aimed to investigate the influence of action-outcome contingency on motivation from control. Participants were asked to press 1 of 4 buttons as randomly as possible. Each of the 4 buttons was assigned a probability of causing a dot to flash (either 0%, 30%, 60% or 90% chance of flash following button press) as in the original paradigm (Karsh & Eitam, 2015). Additionally, a contingency manipulation was employed where the likelihood of a dot flash occurring in the absence of a button press was manipulated (either 0%, 30%, 60%

or 90% chance of flash without button press) and varied in blocks throughout the experiment. A significant interaction between probabilities of internally and externally caused flashes was found. This was due to reaction times being fastest when participants had objectively more control (higher action-outcome contingency) over the dot flash. Additionally, individual differences in Alexithymic and Autistic traits predicted the relationship between reaction times and contingency. Altogether, the current findings replicate and extend prior work by highlighting the importance of action-outcome contingency and individual differences in motivation from control.

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.. (4511) ..

**New evidence for a saccadic range effect.** ANDRÉ KRÜGEL; *University of Potsdam, Germany*

Human motor behavior depends on the combination of noisy sensory information and learned prior knowledge about fundamental task statistics such as the range and the likelihood of response alternatives (Wolpert & Landy, 2012). Depending on these task statistics, prior knowledge often generates range effects such as a motor central-tendency bias (Körding & Wolpert, 2004; Vilareze et al., 2012). However, when it comes to eye movements there is a recent controversy about the general existence of a range effect in the saccadic system (Gillen, Weiler, & Heath, 2013; Nuthmann et al., 2016). Here I argue that these studies draw their conclusions from experimental paradigms with uninformative priors and highly precise saccade targets, which contradict the presence of a range effect in saccades. Based on prosaccade experiments with informative prior distributions and reduced precision of the sensory likelihood I demonstrate that there is a range effect in the saccadic system. Furthermore, I show that the range effect varies in size depending on the nature of the prior and the sensory likelihood as predicted by a recent framework of Bayesian saccade planning (Engbert & Krügel, 2010).

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## Poster Session IV S16, Wednesday, 10:40 – 12:00

.. (4601) ..

**How the speed of auditory stimuli influences their perceived duration: music vs. speech.** MIRIA PLASTIRA & MARIOS AVRAAMIDES; *University of Cyprus, Cyprus*

Research on time perception suggests the presence of an internal mechanism that operates like a clock to provide information about durations and elapsed time. The aim of the present study was to examine, using a time reproduction task, whether the operation of this internal clock is influenced by the perceived speed of presented speech and music stimuli. In Experiment 1, participants were asked to listen to a speech sounds of varying duration and speed and reproduce them by pressing the spacebar for a duration equal to that of each sound they had just heard. In Experiment 2, participants carried the same task with music excerpts.

Across the two experiments, results showed that the speed of the auditory stimuli influenced the estimates of their duration. Overall, actual durations were underestimated and reproduction error was greater when speed increased. Notably, reproduced durations for speech were on average closer to actual durations than were the reproduced durations for music. The implications of these findings for time perception are discussed.

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**Challenging the Partial Awareness Hypothesis: Weak conscious experience sufficient for semantic knowledge.** SIMON HVIID DEL PIN<sup>1,2</sup>, ZUZANNA SKÓRA<sup>1</sup>, KRISTIAN SANDBERG<sup>2</sup>, MORTEN OVERGAARD<sup>2</sup> & MICHAŁ WIERZCHOŃ<sup>1</sup>; <sup>1</sup>*Institute of Psychology, Jagiellonian University, Poland*; <sup>2</sup>*Cognitive Neuroscience Research Unit, CFIN, Aarhus University, Denmark*

There are diverging theories on how much of the external world is represented when we feel that our experience is weak. According to some theories, we represent the world in great detail even though we cannot express this representation clearly. However, the Partial Awareness Hypothesis posits that a weak experience of the world is, in fact, sparse and consists of a fragmentary representation rather than any detailed knowledge. We tested these views in two experiments: Participants were briefly presented with an array of stimuli (natural objects) organised in a circle around a fixation point. After the offset of the presentation, a line pointing towards a stimulus was presented as a cue. In Exp. 1 participants then either choose between two images or two words. One of these stimuli would represent the cued object, while the other would represent an object not presented in the array. In Exp. 2 participants would see a single image/word (representing the cued object in 50% of trials) and judge whether this was the indeed the previously cued object. In both experiments, participants were also asked to judge their experience on a visibility scale (PAS: the Perceptual Awareness Scale).

The rationale was that if participants only exper-

iened fragments of the objects (e.g. single lines or colours), those fragments should often be adequate to select between images but not necessarily so with words. Our results showed that participants performed equally well in the two conditions (image/word) for both experiments. This was also the case when we compared for their weak experiences (PAS-rating 2) only. This implies that even when they had weak experiences, the representations were enough for semantic knowledge.

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.. (4603) ..

**Conflict regulation through flexible stimulus appraisal.** HEIKO REUSS; *Julius-Maximilians-Universität Würzburg, Germany*

One strategy for emotion regulation is to re-appraise potentially aversive stimuli so that they do not lead to a negative emotional response. I investigated whether such a strategy of flexible stimulus appraisal is utilized to avoid conflict (and its aversive nature) in a voluntary task switching paradigm combined with priming. Participants freely chose in each trial to perform either a parity task or a magnitude task on a target number. A preceding prime number was always congruent within one of the two tasks in this trial, and incongruent within the other task. Thus, by their own choice of appraising the stimuli either regarding their parity or regarding their magnitude, participants could either avoid conflict by making the prime a congruent, facilitating stimulus, or face conflict by making it an incongruent, conflicting stimulus. I analyzed the frequency with which participants chose either the conflict-laden or the conflict-free task, and how their response time to the target was influenced by this choice. Strikingly, I found that the conflict-laden task was chosen more often than the other task. Additionally, I found a reversed congruency effect: responses were faster after incongruent primes rather than congruent primes. Overall, the results show that the task choice is influenced by the task-dependent conflict potential of the prime stimulus. However, the direction of the effect is surprising, with a tendency to "create" a conflicting stimulus rather than a harmonious stimulus, and faster responses after conflicting stimuli. The latter finding might hint to a possible explanation: the occurrence of an inhibitory mechanism that reverses an initial activation, which then manifests not only in the RT pattern (a finding which can be observed in priming with particular timing conditions), but also in the counterintuitive task choice.

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.. (4604) ..

**The role of object's perceptual salience and scene's semantics in dual-target search.** SARA SPOTORNO<sup>1</sup>, ANNA MONTAGNINI<sup>2</sup> & BEN TATLER<sup>3</sup>; <sup>1</sup>*University of Glasgow, United Kingdom*; <sup>2</sup>*CNRS & University of Aix-Marseille, France*; <sup>3</sup>*University of Aberdeen, United Kingdom*

**Background:**

The role of low-level factors in scene viewing has been controversial. Previous research has proposed that high-level factors have a greater influence, and this especially in highly constrained tasks like visual search, where it has been shown that viewers are able to ignore perceptually salient distractors. Surprisingly, the role of perceptual salience in scene search when it is task relevant has been often overlooked.

**Method:**

In an eye-tracking study and using Linear Mixed Models, we examined search of two competing targets, both of low salience or one of low and one of high salience, occurring in the same realistic scene together with high and low salience distractors. We also analysed any interplay with high-level guidance supplied by scene context, as the targets could be included in the same semantic scene region (e.g.: meadow) or each in a different region (e.g.: meadow vs. sky). Target verbal templates were supplied sequentially before scene onset.

**Results:**

We showed that, in terms of proportion of initial saccades directed toward a target and of the time needed to first fixate the first target found, a target's high salience facilitated its own search but did not affect search of a low salience competitor. Even though search was better for targets corresponding to first templates and when both targets were in the same semantic region, the target salience effect was independent of template order or target placements in the scene. Moreover, searching for one high salience target or having both targets in the same region reduced overall the number of distractors fixated.

**Discussion:**

These results suggest that viewers are able to utilise low-level properties flexibly and that high salience of targets enhances oculomotor guidance during scene search. They also suggest that salience as source of search guidance may act mainly independently from knowledge of scene context.

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**The study of age, gaze and illumination effects on face evaluation: A new Database.** GIULIA MATTAVELLI<sup>1,2</sup>, ELISABETTA CESANA<sup>1</sup> & PAOLA RICCIARDELLI<sup>1,2</sup>; <sup>1</sup>*University of Milano - Bicocca, Italy*; <sup>2</sup>*Milan Centre for Neuroscience, Milan, Italy*

Face evaluation and first impression generation can be affected by multiple facial and contextual aspects such as invariant facial features (i.e., age and gender), gaze direction and environmental illumination. However, the combined effects of these variables have not been previously investigated. We aimed at studying whether and how these different facial and contextual features affect ratings of social attributes. To this end, we created and validated the Bi-AGI Database, a freely available new set of male and female face stimuli varying in age across lifespan from 18 to 87 years, eye gaze direction and illumination conditions. Judgments on attractiveness, masculinity-femininity, dominance and trustworthiness were collected for each stimulus. Results indicated that these different variables interact in modulating social trait attribution, in particular illumination differently affected ratings across face age, gender and gaze direction, with less impact on older adult faces and greater effect on young faces. This study also allows us to provide high quality photos for future studies in face perception, social cognition, cognitive and social neuroscience.

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**Feature discrimination learning transfers to noisy displays in complex stimuli.** ORLY AZULAI<sup>1</sup>, LILACH SHALEV<sup>1</sup> & CARMEL MEVORACH<sup>2</sup>; <sup>1</sup>*Tel Aviv University, Israel*; <sup>2</sup>*University of Birmingham, UK*

Perceptual learning through repeated exposure to near threshold stimuli can result with dramatic improvement in stimuli identification. Such improvements, however, tend to be quite specific and transfer effects are scarce. One interesting exception is the asymmetric transfer exhibited when the stimuli may (or may not) incorporate external noise. In their influential work, Doshier and Lu (2005) have found that training in a simple Gabor orientation discrimination with low external noise improved performance in both low and high noise displays, whereas high noise training did not transfer to low noise performance. However, it is not clear whether these transfer effects can occur with complex stimuli as previous studies tended to focus on simple low-level perceptual processes such as motion, orientation of depth perception. In the current study we assessed this question by using complex stimuli of human faces, which are classified as real world stimuli and are important for everyday visual processes of social information. Three

groups of participants were tested on their ability to identify a face presented with external white noise before and after training in the same task (high noise training group), training in fine discrimination of the same faces which were morphed together (low noise training group) or with no training (baseline group). Our results show clear transfer effect in the low noise group who showed improvement comparable to the high noise training group. These findings suggest that fine feature discrimination training can show transfer effects to noisy displays even with complex stimuli (faces). These results extend previous findings regarding transfer of fine-feature learning to signal-in-noise using real-life stimuli and point to the possible beneficial use of fine feature training in individuals with noise filtering deficits (such as ADHD or dyslexia)

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**The effect of "objecthood" in the Ebbinghaus illusion.** EINAT RASHAL, ALINE F. CRETELOUD & MICHAEL H. HERZOG; EPFL, Switzerland

In the Ebbinghaus illusion, observers overestimate the size of a target when it is surrounded by large flankers and compared with a control target surrounded by small flankers. We examined whether "objecthood" – the degree to which an object is a cohesive entity – plays a role in the illusion. We predicted that the magnitude of the illusion will decrease with decreased objecthood. To test this hypothesis, we presented observers with squares as target and flankers, and manipulated the degree of their objecthood in two ways; a) the squares were composed of different parts (i.e., corners or edges) in different trials. Corners usually produce more cohesive squares than edges because the former combine closure, symmetry and collinearity, whereas the latter lacks collinearity; b) the gap size between the object parts was varied, so that larger gaps produced less cohesive objects than smaller gaps. The participants adjusted the test target to match a control target in size. Our results show that increasing the gap size between object parts reduced the magnitude of the illusion. In addition, the magnitude of the illusion was greater when the target was composed of its edges compared with when it was composed of its corners. These results suggest that objecthood plays a role in the Ebbinghaus illusion.

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.. (4608) ..

**Operational momentum in line and time production.** GIOVANNA MIONI<sup>1</sup>, MARTIN H. FISHER<sup>2</sup> & SAMUEL SHAKI<sup>3</sup>; <sup>1</sup>University of Padova, Italy; <sup>2</sup>Potsdam University, Germany; <sup>3</sup>Ariel University, Ariel

**Background:**The Operational Momentum (OM) effect is characterized by a tendency to overestimate addition and to underestimate subtraction results. Previous work found regular OM with zero problems but reverse OM with non-zero problems. The present work aimed to replicate the dissociation found between zero and non-zero problems in a population of left-to-right readers, and test if OM and reverse OM effects emerge also in a time production task. **Method:**In Experiment 1, left-to-right readers performed the line-production task (Shaki et al., in press). Stimuli consisted of 20 arithmetic problems with outcomes 3, 4, 5, 6, and 7: ten zero problems (e.g., 3+0, 3-0), and ten non-zero problems (e.g., 2+1, 4-1). Half the problems of each type were additions, the other half subtractions. Participants used up/down arrow keys to perform the task. In Experiment 2, the same arithmetic problems were used in a time-production task where participants' task was to produce durations by pressing the spacebar. In Experiment 3, we replicated both line and time production tasks (within-subject design). Note, in this experiment participants used the spacebar for line-productions as well to completely eliminate any possible spatial bias due to the production procedure. **Results:**We replicated the dissociation found by Shaki et al., (in press) in line length production with left-to-right readers (Experiment 1), as well as when no spatial responses were needed (Experiments 2 and 3). Participants produced longer lines for additions than subtractions in zero problems; the opposite pattern was found for non-zero problems, demonstrating a reverse OM effect. Moreover, the same pattern was found in time production (Experiments 2 and 3). **Discussion:**Our results support the model of heuristics and biases in mental arithmetic, which suggests the presence of multiple competing sources of bias in mental arithmetic. Moreover, finding OM in time production, which is not spatial by nature, suggests that OM is not a result of spatial biases alone.

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**Is Numerical Knowledge Always Linked to Finger Gnosia in an Anatomical Way?** NOLWENN GUEDIN<sup>1</sup> & CATHERINE THEVENOT<sup>2</sup>; <sup>1</sup>University of Geneva, Switzerland; <sup>2</sup>University of Lausanne, Switzerland

In children, performance on a finger gnosia test, which measures finger perception, has been revealed as a better predictor of mathematical skills

than classical tests measuring intelligence. Two different explanations can account for this surprising result. First, this relationship between fingers and numbers can be accounted for a neuroanatomical overlap of the brain areas specialized in finger perception and numerical processing. Second, this relationship could stem from a functional link between fingers and numbers, through finger counting for example. In our study, we examined these two explanations by assessing non-symbolic skills in children suffering from cerebral palsy and thus presenting finger motor impairments. Non-symbolic numerical skills correspond to the ability of estimating the numbers of objects in collections. Some researchers hypothesize that these skills are innate. According to the neuroanatomical explanation, all numerical abilities, including non-symbolic ones, should be impaired in children with finger gnosis impairments. In contrast, within the functional hypothesis, non-symbolic numerical skills should be preserved in children with weak finger gnosis because finger counting, or more generally the involvement of fingers in numerical processing, develops after non-symbolic skills.

In this study, we assessed numerical and general skills in 31 children with hemiplegia presenting cerebral palsy. Within this population, we found two children who allow us to report a double dissociation. Both children presented dexterity deficits and preserved cognitive abilities. However, one child presented good finger gnosis and difficulties in a comparison task on non-symbolic numerical material, whereas one other presented impaired finger gnosis but preserved non-symbolic numerical skills. This double dissociation suggests that numerical knowledge is not always linked to finger gnosis in a strictly anatomical way. At least for children with cerebral palsy, recruitment of the neuronal areas responsible of the innate treatment of quantities can be independent from those dedicated to fingers.

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.. (4610) ..

**The effect of aging on sensitivity to interference in multiplication solving: a diffusion model analysis.** KIM ARCHAMBEAU<sup>1</sup>, LEENDERT VAN MAANEN<sup>2</sup>, BIRTE FORSTMANN<sup>2</sup>, MARIE-PASCALE NOËL<sup>3</sup> & WIM GEVERS<sup>1</sup>; <sup>1</sup>*Center for Research in Cognition & Neurosciences, Université Libre de Bruxelles, Belgium*; <sup>2</sup>*Integrative model-based cognitive neuroscience, University of Amsterdam, Netherlands*; <sup>3</sup>*Psychological Sciences Research Institute, Université Catholique de Louvain, Belgium*

Arithmetic facts are required when solving problems such as "3x4" and are frequently used in everyday life situations. They refer to calculations for which the correct answer is retrieved from

memory and they are stored in interconnected associative networks (Ashcraft, 1992). Numerical problems, operands and answers are densely interconnected memory structures causing interference between these associations. The presentation of a problem (e.g. 3 x4) activates different memory representations among which the correct solution (12) and table-related neighbours (e.g. 16) which may interfere during memory retrieval.

The main aim of this study is to investigate whether arithmetic facts are affected by the increase of sensitivity to interference in memory with aging (e.g. Jonides et al., 2000). To do so, both young and older adults performed a multiplication verification task with operand-related lures and a recent-probes task designed to directly measure the sensitivity to interference in numerical and non-numerical domain respectively. We then applied diffusion modelling to our data for the first time in this domain. Such models allow for detailed psychological interpretations concerning the processing mechanisms underlying the performance (e.g. decision bias, response caution, processing efficiency or peripheral processes).

Diffusion models fitted well the performance of the younger adults. This demonstrates that such models can be applied to novel tasks like mental calculation. The modelling results indicate that processing efficiency, but not the other parameters, can account for the sensitivity to interference in both tasks. The modelling of older adults is still in progress.

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**The Exact Shift: From exact to approximate representation of discrete magnitudes in early grade school.** SHAI ITAMAR & AVISHAI HENIK; *Ben-Gurion University, Israel*

Central theories in the field of Numeric cognition suggest that discrete magnitudes are processes differently from continuous magnitudes. While discrete magnitudes are represented and processed in an exact fashion (Number Sense Theory, Deheane, 1993; Two Core Systems, Feigenson et al. 2004), continuous magnitudes are represented and processed in an approximate fashion (The Approximate Number System, Cantlon et al., 2009; Halberda & Feigenson, 2008). Recent findings suggested that this is not the case. Namely, it was found that while continuous representation remains approximate throughout early grade-school years, discrete representation changes from being exact to being approximate between the 3rd and 5th grades. It was suggested that the acquisition of the symbolic system renders the discrete system ineffective as an exact system, a process which manifests in discrete magnitudes representation. The cur-

rent study aimed at exploring this Exact-Shift hypothesis. In this study grade-school children completed two stoop-like tasks which were designed to explore both symbolic and discrete automatic processing. Results pattern supported the Exact-Shift hypothesis by showing that discrete processing patterns change between the 3rd and 5th grade in a way that indicates a transition from exact to approximate representation.

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.. (4612) ..

**Effects of the experimental context in numerosity judgments.** MICHAËL VANDE VELDE & ALAIN CONTENT; *Université Libre de Bruxelles, Belgium*

Judgments in dot comparison tasks are not only driven by the numerosities of the arrays but are also influenced by visual features such as aggregate area. Typically, participants are more accurate when a non-numerical visual cue is congruent with numerosity than when it is not. To account for these effects, several authors have proposed that numerosity judgments are made through a weighting process. According to these models, the weight of each visual feature in the decision is purely stimulus-driven; that is, it only depends on the characteristics of the current stimulus. In this study, we investigated whether the experimental context, defined here as the composition of the stimulus sets, also impacts the weighting process.

In this perspective, we conducted three experiments in which we manipulated the overall validity of the aggregate area and of the mean dot size. To this end, experimental congruent and incongruent stimuli were combined with different sets of additional trials to vary the global proportion of congruent and incongruent trials with regards to each dimension. Importantly, the performance was evaluated only on the trials that were shared in all experiments. Based on previous studies indicating that the influence of visual cues varies with stimulus display time, we additionally contrasted short and unlimited display conditions.

The performance differed dramatically between the first two experiments, suggesting that area and/or dot size weight is influenced by the composition of the stimulus set. The third experiment indicated that the effect was mainly due to a reweighting of dot size. Importantly, the experimental context exerted an effect in the absence of any corrective feedback. To account for the adaptation, we propose the existence of an internal feedback on numerosity that allows to experience conflicts and leads to modification of the priors on the link between numerosity and non-numeric visual features.

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.. (4613) ..

**Numerical magnitude spatially biases unusual responses.** CLAUDIA GIANELLI<sup>1</sup>, KATHARINA KÜHNE<sup>1</sup> & ROSA RUGANI<sup>2</sup>; <sup>1</sup>*University of Potsdam, Germany*; <sup>2</sup>*University of Padova, Italy*

Numbers are represented on a Mental Number Line (MNL), usually oriented from left-to-right. Along the MNL smaller numbers are located on the left side and larger ones on the right side (Dehaene, 2011). The first, and often replicated, experimental demonstration of the MNL is the fact that adult humans are faster at processing small numbers when responses are executed on the left side of space, and at processing larger numbers when responses are executed on the right side of space (spatial-numerical association of response codes: SNARC effect; Dehaene et al. 1993). To date, the majority of studies have investigated this effect by means of response times and forced-choice paradigms which are influenced by cultural biases, whereas studies considering a spatial selection of choice are rare.

Here we present a new "free response" task, which allows understanding what response is selected. Participants were seated in front of a Greek cross. In each test trial, they were visually presented with numerical (1, 3, 5) and non-numerical symbols (\$). They were instructed to touch either the left or right end of the horizontal bar of the Greek cross, as soon as a symbol appeared on a monitor. To be sure that participants processed the numerical magnitude, a go/no-go task has been used: participants were instructed to execute the movement whenever the symbols 1, 5, or \$ appeared, but to do not respond to the number 3. Data show that numerical magnitude significantly affected the direction of choice. In particular, participants performed more right responses responding to the large number (5). No side-bias was shown for the non-numerical symbol.

Overall, our study suggests that the spatial representation of numerical magnitude plays a role in determining which of two responses was selected.

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.. (4614) ..

**Adaptation to Illusory contours reveals a discrete numerosity perception.** ANDREA ADRIANO, ALAIN CONTENT & MICHAËL VANDE VELDE; *Université Libre de Bruxelles, Belgium*

How numerosity is visually extracted is still an open debate oscillating between theories assuming a dedicated system that relies on items-individuation and theories suggesting that numerosity processing exploits summary statistics over non-numerical visual features (e.g. density). Numerosity adaptation (i.e., when exposure to an array of objects shifts the perceived numerosity of the subsequently presented array) has been taken

as evidence for the former theories. However it is still unclear whether adaptation influences numerosity perception directly by tapping over number-tuned neurons or indirectly via mechanisms linked to texture-density processing.

Here, to disentangle which visual feature is actually at play, we used a new adaptation paradigm in which the participants were first exposed to arrays of “illusory” objects before performing a comparison task on arrays of real dots. Using arrays of objects generated by illusory contours (Ehrenstein Grid) allowed us to decouple adaptation effects on numerosity and texture-density since, in this type of array, numerosity is correlated negatively with texture-density. Indeed, if adaptation taps on the discrete numerosity, then adaptation to a small set of IC’s objects (12 dots) should push upward the perceived numerosity of a following bigger numerical set (24 dots), whereas if adaptation relies on texture-density, then adaptation to the high “textured” inducer-grid should push downward the perceived numerosity of a following less dense stimulus (24 dots). Subjects were tested in a comparison-task between a reference (24 dots) and a variable test stimuli (12-48) and PSE’s were calculated pre and post Ehrenstein-grid adaptation.

Results showed that after adaptation to Ehrenstein grid, the PSE increases respect to the no-adaptation phase. The direction of this effect is predicted by theories assuming the existence of a “discrete” numerosity perception. In sum, our results suggest that numerosity can be actually adapted independently from texture-density processing.

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## Poster Session IV

S17, Wednesday, 10:40 – 12:00

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**How to obtain typical working memory training outcomes after just one training session: it’s in the strategies.** MATTI LAINE<sup>1,2</sup>, DANIEL FELLMAN<sup>1</sup>, OTTO WARIS<sup>1</sup> & THOMAS NYMAN<sup>1</sup>; <sup>1</sup>*Åbo Akademi University, Finland*; <sup>2</sup>*Turku Brain and Mind Center, University of Turku, Finland*

**Introduction:** It has been suggested that current working memory (WM) training with its very limited transfer may be related to task-specific strategies that participants develop during training. If this were the case, even very short explicit training of an effective strategy for the trained WM task could elicit similar results, namely near transfer to tasks that are structurally similar to the training task, and very little transfer beyond that.

**Objectives:** We examined whether very short WM strategy instruction/training could elicit a similar pattern of transfer as has been seen after the common 4-6-week unsupervised adaptive WM training.

**Methods:** 118 young healthy adult participants were block-randomized into three groups: an instructed training group (n=40) who were given a visuospatial strategy for the digit n-back training task, an uninstructed training group (n=38), and a passive control group (n=40). The two training groups trained online with adaptive digit n-back task for a single half-an-hour session, while the passive control group only participated in the pre/post tests. The pre/post measures tapped success in the training task (the adaptive digit n-back task), task-specific near transfer (untrained n-back tasks with letters and colors), and task-general near transfer (digit span, selective updating of digits, running memory with digits).

**Results:** Compared with both the uninstructed training group and the passive control group, the instructed training group showed disproportionately larger improvement on the trained n-back task as well as on the untrained n-back transfer tasks, but not on the other WM tasks. We thus replicated the typical transfer pattern in WM training studies in the instructed training group.

**Conclusion:** Development of task-specific strategies (that can take some time in ordinary WM training where no strategy instructions are given) is a viable explanation for the pattern of transfer effects that has been observed after WM training.

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.. (4702) ..

**Consolidation or Restoration: Words versus Non-words.** SÉBASTIEN DE SCHRIJVER & PIERRE BARROUILLET; *University of Geneva, Switzerland*

Consolidation is the process by which ephemeral sensory traces are transformed into more stable short-term memory traces. In a previous study, De Schrijver and Barrouillet (2017) observed that increasing the time available for consolidation resulted in higher WM spans in the same extent as increasing the time available for restoration. Moreover the two factors interacted and more consolidated memoranda proved more resistant to variations in cognitive load (CL), and thus more resistant to decay. Additionally, when consolidation time was added to restoration time in calculating CL, the new resulting index, called extended CL, proved a very good predictor of recall performance. This suggests that consolidation and restorative processes are at least partially substitutable in strengthening memory traces.

The present study aimed at comparing the impact of familiarity on consolidation and restoration.



Participants performed a complex span task with either words or non-words as memory items, each of them being followed, after a delay for consolidation of either 500 ms or 3000 ms, by either 2 or 4 distractors to process in 4 seconds (for low and high CL, respectively). Longer consolidation time resulted in better recall for both types of memoranda, but the effect was smaller for non-words than words, while variations in CL affected word spans, but not non-word spans. These results suggest that familiarity affects the effectiveness of both consolidation and restoration processes, probably due to differences in representation quality or accessibility. Email: Sebastien.DeSchrijver@unige.ch

.. (4703) ..

**Temporal dynamics of maintenance in young and old adults: An impairment of attentional refreshing in aging.** LISON FANUEL<sup>1,2,3,4,5</sup>, GAËN PLANCHER<sup>1</sup>, NOË MONSANGEON<sup>6</sup>, BARBARA TILLMANN<sup>2,3,4,5</sup> & SOPHIE PORTRAT<sup>6</sup>; <sup>1</sup>*Cognitive Mechanisms Research Laboratory, Lyon 2 University, Bron, France*; <sup>2</sup>*CNRS, UMR5292*; <sup>3</sup>*INSERM, U1028*; <sup>4</sup>*Lyon Neuroscience Research Center, Auditory Cognition and Psychoacoustics team, Lyon, France*; <sup>5</sup>*University Lyon 1, Lyon, France*; <sup>6</sup>*Psychology and NeuroCognition Laboratory, CNRS, UMR5105, Univ. Grenoble Alpes, Grenoble, France*

Recent models have proposed that maintenance in working memory is supported by attentional refreshing (Barrouillet, Portrat, & Camos, 2011). This mechanism consists in reactivating memory traces to maintain their activation over time and counteract their decay. Using a new paradigm, Vergauwe, Camos and Barrouillet (2014) reported that response times for processing concurrent information linearly increased with the memory load at a rate of 50 ms per memory item, suggesting that attentional refreshing is a very fast acting mechanism in young adults. However, in the elderly, attentional refreshing seems to be impaired (Johnson et al., 2004). In the present study, using the same experimental paradigm as Vergauwe et al. (2014), we investigated the influence of memory load on response times for processing concurrent information in young and old adults. Zero to five squares, which were sequentially displayed in random locations on the screen, had to be memorized. Then, participants performed a self-paced parity judgement task for 12 seconds before serial recall of the squares' locations. Using the data selection of Vergauwe et al., series up to four memoranda in young adults and up to two memoranda in old adults were analyzed. Response times of parity judgement were distinguished between responses to the first digit and to subsequent digits. As expected, both first and subsequent response times linearly increased with memory load

in young adults, reflecting respectively consolidation and maintenance of the memory traces (Vergauwe et al., 2014). In the elderly, a different pattern was observed: (a) the first response time was longer with than without memorization, reflecting switching between memory and processing tasks rather than memory trace consolidation; (b) in contrast to young adults, subsequent response times were not affected by memory load. These findings suggest an impairment of attentional refreshing, which might explain deficits in working memory in aging. Email: lison.fanuel@univ-lyon2.fr

.. (4704) ..

**Controlling for output interference does not abolish selective directed forgetting.** CARMEN AGUIRRE<sup>1</sup>, CARLOS J. GÓMEZ-ARIZA<sup>2</sup> & M. TERESA BAJO<sup>1</sup>; <sup>1</sup>*Research Center for Mind, Brain and Behavior, University of Granada, Spain*; <sup>2</sup>*University of Jaen, Spain*

It is widely known that people can forget previously learned information when cued to do so, and the directed forgetting (DF) effect has been broadly replicated. With an adapted list-method directed forgetting procedure, Delaney et al. (2009) opened a new line of research by demonstrating that DF can also be selective. In the selective directed forgetting (SDF) procedure participants are cued to forget only one set of previously studied items, and results show a specific forgetting effect only for those items cued to forget. In a recent experimental series, Aguirre et al., (2017) found compelling evidence that a) SDF recruits executive control b) the effect is not a consequence of selectively rehearsal of the items cued to remember. In addition, post-hoc analyses suggested that SDF was not accounted for output interference during the memory test. In the present experiment we directly test this idea by asking participants to recall the to-be-forgotten items before they were to recall the to-be-remembered items. Observing SDF under this testing procedure would strongly rule out output interference as a cause of the selective memory impairment for the to-be-forgotten items. The results of the study straightforwardly show that SDF is a reliable effect even when output interference is not possible. This finding joins previous ones to support the idea that SDF is a motivated forgetting phenomenon that stems from control mechanisms in charge of making specific information less accessible.

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.. (4705) ..

**Improvisation theatre helps reduce anxiety...and memory!** ANNA-GAËLLE LAMBERT<sup>1</sup> & MATHIEU HAINSELIN<sup>2,1</sup>; <sup>1</sup>*Département de Psychologie, Université de Picardie Jules Verne, Amiens, France;* <sup>2</sup>*CRP-CPO, EA 7273, Université de Picardie Jules Verne, Amiens, France*

Background: Improvisation theatre (improv) is supposed to improve self-confidence, letting go, well-being, creativity, memory and anxiety. However, there is no supportive scientific evidence of these claims, based only on comedians' feelings. This study is, in our knowledge, the first to assess the impact of improv on anxiety and memory.

Methods: Twenty-two participants (18-25 years old, 11 males / 11 females) were randomized into a two hours improv session (N= 11) or a two hours comedy movie watching control group (N = 11). None of them had improv training experience. Improv exercises were classic ones for discovery session. Anxiety and memory assessments were conducted immediately before and after the session (improv or movie). Anxiety was assessed by means of the French Version of the State-Trait Anxiety Inventory (STAI), the first part of which concerns state anxiety and the second part concerns the trait anxiety. Memory was assessed by means of the Wechsler Memory Scale stories. Results were analyzed with Student t-test.

Results: The two groups did not differ for any measure during the pre-session assessment. For the improv group, all three scores were lower after the session for the improv group participants in comparison to the pre-session assessment ( $p=.01$  for state anxiety,  $p=.03$  for trait anxiety,  $p=.01$  for memory). For the control group, only the state anxiety score was lower after the session ( $p<.01$ ); there was no pre/post difference for trait anxiety ( $p=.40$ ) nor memory ( $p=.43$ ) scores.

Discussion: As expected, a single improv session helps reduce state anxiety, as movie watching did. More surprisingly, it also help reduce trait anxiety and memory. Participants claimed to feel happy but tired after the improv session, and tiredness might be an explanation for lesser memory performances. Future research are need to explore the long-term effects of improv on anxiety and cognition.

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.. (4706) ..

**What Mouse Tracking Reveals About Prospective Memory and Intention Deactivation.** MARCEL KURTZ, STEFAN SCHERBAUM & MORITZ WALSER; *TU Dresden, Germany*

Event-based prospective memory (PM) describes the ability to postpone intention performance until the appropriate event triggers its retrieval. Previous work revealed that intentions

are not necessarily deactivated after completion, but might residually persist, especially when participants had to monitor for novel PM cues. We aimed at clarifying the processes underlying these so-called aftereffects of completed intentions. Specifically, we used mouse tracking to analyse the temporal dynamics and sub-processes of aftereffects. We used a mouse tracking version of the repeated PM cue paradigm. As PM task, participants first responded to rarely occurring symbols (i.e., PM cues) within an ongoing task. We manipulated the task following PM-task completion. That is, participants either had to monitor for novel PM cues (monitoring condition), or exclusively performed the ongoing task (no monitoring condition). In both conditions, no-more-relevant PM cues (i.e., repeated PM cues) from the previous PM task were presented. In line with previous work, we found slowed ongoing-task responses as well as increased aftereffects in the monitoring as compared to no-monitoring condition. First analyses of mouse trajectories indicate a reflexive-associative process rather than a noticing plus search process underlying aftereffects.

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.. (4707) ..

**The interplay of cortisol and time of the day on prospective memory performance.** NICOLA BALLHAUSEN, MATTHIAS KLIEGEL & ULRIKE RIMMELE; *University of Geneva, Switzerland*

Prospective memory (PM) refers to the memory for future intentions. This cognitively demanding capacity was suggested to be negatively impacted by stress. However, studies investigating the influence of stress of PM performance show mixed results: While some studies showed lower PM performance under high stress conditions, in other studies PM performance was not affected by stress. Most of these studies manipulated stress by inducing subjective stress with a social stress test (TSST). Yet, these studies are limited by the fact that the subjective effects of the stress induction might vary across individuals and that social stress tests affect both the sympathetic nervous system as well as the HPA axis, therefore resulting in enhanced cortisol levels.

To address this, in the present double-blind, placebo-controlled study we directly varied cortisol levels by an oral pharmacological intake of 10-mg cortisol mimicking physiological responses to stress. This was done at either 13h (after lunch) or 15h. Afterwards, participants had to work on a one-back ongoing task and additionally had to respond to two pre-defined PM target cues.

Preliminary analyses show an interaction of cortisol with time of the tablet administration, in detail PM performance was boosted when given at

13h, but lowered at 15h.

Results are discussed with regard to PM literature on stress as well as the impact of circadian rhythms.

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.. (4708) ..

**Changing memories and emotions.** SIMON NØRBY; Aarhus University, Denmark

Can people change their memories in order to regulate their emotions? Emotion regulation includes attempts to influence when and how emotions are experienced and expressed. Traditionally, such regulation has been conceived of as proactive (e.g., situation selection) or reactive (e.g., attentional distraction), but I propose that it may also be retroactive and target memory. I term such past-oriented activity mnemonic emotion regulation and suggest that it may involve increasing or decreasing access to a memory or changing the memory itself. People may attempt to increase access to a memory, making it more likely that it will be retrieved in the future, for example by rehearsing a pleasant memory. They may try to decrease access to a memory, making it less likely that unwanted intrusions are experienced in the future, for example by repeatedly trying to stop a memory from being retrieved. Finally, people may attempt to alter the content of a memory, for example by replacing negative impressions with constructive interpretations. I discuss different lines of research that bear on these possibilities (e.g., on elaborate rehearsal, memory suppression and memory distortion) as well as the different motives (e.g., hedonic, instrumental and self-related motives) people may have for engaging in mnemonic emotion regulation. Also, I discuss possible individual differences in mnemonic emotion regulation (e.g., in depression versus mental health).

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.. (4709) ..

**Target and source emotional memory of visual stimuli – A large cohort study.** ALINA-ALEXANDRA SAVA<sup>1</sup>, LIONEL LANDRÉ<sup>1,2</sup> & HANNA CHAINAY<sup>1</sup>; <sup>1</sup>University Lyon 2, France; <sup>2</sup>INSERM U1077 NIMH, Université Caen-Normandie

Background: Memory for emotional stimuli is better than for neutral ones (Labar & Cabeza, 2006). Less is known about the influence of emotions on the “source” memory (where and when stimuli were previously encountered). Two main hypotheses have been advanced: First, Easterbrook (1959) argued that people narrow their attention to the emotional stimuli and ignore peripheral or background information. Second, the tick rate hypothesis (Revelle & Loftus, 1992) asserts that people

pay greater attention to all aspects of an emotional event, both central and peripheral. Thus, the Easterbrook prediction suggests that source memory should be worse for emotional than for neutral information, while the tick rate hypothesis suggests that it should instead be better. The main objective of our study was to explore the influence of emotions on memory for target and source information in a large cohort.

Method: Stimuli were 200 color photographs of negative (high and low arousal), neutral and positive (high and low arousal) objects. 502 healthy young participants (age=18,9, ET=2,02) completed two encoding phases in which one half of the stimuli was seen “in a painting frame” and the other half “in a window”. At retrieval, participants completed a recognition task. For each “yes” answer (i.e., meaning that the stimulus was previously seen), participants had to say if the image was previously seen 1) in a frame or in a window, and 2) during the first or the second encoding phase.

Results: Our results showed an enhancement of memory performance for both target and source for emotional stimuli as compared with neutral ones. This effect was stronger for high-arousal than for low-arousal stimuli and for negative than for positive stimuli.

Discussion: Our results confirm the tick rate hypothesis (Revelle & Loftus, 1992) and bring interesting light on the influence of valence and arousal on source memory.

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.. (4710) ..

**The role of memory and metamemory in evaluative conditioning.** LAURENT WAROQUIER<sup>1</sup>, MARLÈNE ABADIE<sup>2</sup> & ZOLTAN DIENES<sup>3</sup>; <sup>1</sup>Université Clermont Auvergne; <sup>2</sup>Université de Fribourg; <sup>3</sup>University of Sussex

Evaluative conditioning (EC) refers to a change in liking of a conditioned stimuli (CS) consecutive to its repeated pairing with a valent stimuli (US). We investigated the role of memory and of metamemory of US valence across two experiments. For this purpose, we adapted the knowledge attributions method (Dienes & Scott, 2005). This method is based on the phenomenological experience of the participants while performing the memory test. More specifically, on each trial of this test, participants made a metacognitive judgement about the basis of their response. Memory, feeling based and guess attributions were distinguished. Accuracy at the memory test was above chance level for memory and feeling based attributions but not for guess attributions. We then tested whether EC occurred for the CS for which these different types of attributions were made. The meta-analyses of the two experiments provided evidence that evaluat-

ive conditioning may occur for the three types of attributions. While the effect size was medium for memory attribution it was small for feeling based and guess attributions. Moreover, experiment 2 included a delayed test. EC was still significant 24 hours after the conditioning took place. The results obtained for memory and feeling based attributions suggest that both explicit and implicit may play a role in EC. However the results obtained for guess attribution suggest that EC may also occur without memory of US valence.

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.. (4711) ..

**Intrusion Effect in Visual Working Memory with the Modified Sternberg Task.** YING-YU CHEN<sup>1</sup>, LEE-XIENG\* YANG<sup>2</sup> & HSUAN-YU LIN<sup>3</sup>; <sup>1</sup>*Chung Yuan Christian University*; <sup>2</sup>*National Chengchi University*; <sup>3</sup>*University of Zurich*

In the short-term recognition task which requires remembering both content and context of the memory items, the performance of intrusion probe, where the content matches one of the item but the context mismatch, is worse than the new probe, the content and the context both mismatch. Intrusion cost, the performance difference between intrusion and new probe, is often interpreted as the interference from the content associated with mismatching context, and the interval between context and probe onset (CSI) modulated the intrusion cost, which the short CSI induced larger intrusion cost (Oberauer, 2005). In this study, we adapted the paradigm used by Oberauer (2005) but replaced the verbal stimulus with visual material to investigate if the same mechanism exists in VWM. In this study, we modified the modified Sternberg task as a visual working memory task. In the training phase, there were two learning stimuli lists, each of which were a number of color squares embedded in a white frame in a circular or diamond shape. The squares were randomly displayed at different locations on the computer screen. On each test trial, the cue (a diamond or a circle) was presented first and followed by a color square for which the participants should judge whether or not it was previously seen. The independent variables in this experiment were the setsize (from 1 to 4), the probe type (50% positive and 25% negative and 25% intrusion), and the CSI (0.3 sec or 2 sec). The results showed clear intrusion and setsize effects on RT and accuracy. However, the results also showed strong evidence against the interaction between CSI and intrusion cost, unlike previous studies. It is implied that visual and verbal material might have different process of selecting the relevant list, especially on the process of resisting interference from the non-cued list.

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.. (4712) ..

**The role of attention in subjective accessibility of memory representation.** ZUZANNA SKÓRA<sup>1</sup>, SIMON HVIID DEL PIN<sup>1,2</sup> & MICHAŁ WIERZCHON<sup>1</sup>;

<sup>1</sup>*Consciousness Lab, Institute of Psychology, Jagiellonian University, Krakow, Poland*; <sup>2</sup>*Cognitive Neuroscience Research Unit, CFIN, Aarhus University, Aarhus, Denmark*

Orienting attention retrospectively (retro-cue) to the content of memory representation influences performance on a subsequent memory test. There are at least two possible modes of retro-cue influence: it enhances the precision of memory representation or subjective accessibility of that representation. We have designed a study combining change detection task with a partial report paradigm. Participants were presented with a memory array consisting of 6 natural objects. After a 1 s-long blank display, a spatial cue was presented indicating the area that a change in one of the objects would most probably occur. There were 3 within-subject conditions: (1) the cued object would change (45% of time); (2) neighbours of the cued object would change (22.5% each); (3) a different object would change then the ones mentioned before (10%). Participants were informed of this rule and encouraged to focus on the area closest to the spatial cue. The cue was followed by a test array with a framed target object. The task was to answer whether a change of the target has occurred. Lastly, they were asked to provide a visibility rating (Perceptual Awareness Scale) regarding the target just after the spatial cue was presented. The data analyses were done using Hierarchical Signal Detection model. The parameter of interest is  $M_{ratio}$  ( $meta-d'/d'$ ), which serves as a measure of subjective accessibility. If retro-cue influences subjective accessibility we expect to observe a higher  $M_{ratio}$  for condition 1 (valid cue) than the other two conditions. What we have observed was that the  $M_{ratio}$  for the valid cue condition was, in fact, smaller than the one for the invalid cue condition. At the same time, the performance ( $d'$ ) in the detection task was better for the valid cue condition. Study design and planned analyses were preregistered before data collection.

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.. (4713) ..

**Can working memory both promote and hinder mind wandering?** ALEXANDER SOEMER & ULRICH SCHIEFELE; *University of Potsdam, Germany*

Humans occasionally mind wander in situations that require mental focus on a given primary task. Such off-task thinking has been associated with impairments in performance, particularly, when the primary task is at least moderately demanding. A central issue in mind wandering research is the question why certain individuals mind wander

more than others and what role working memory plays with regard to individual differences in mind wandering. According to some accounts of mind wandering, working memory is used to sustain a mind wandering episode, while according to others, working memory is used for suppressing it. The present contribution discusses the possibility that working memory can actually both support and suppress mind wandering episodes depending on whether these episodes are voluntarily or involuntarily initiated. Working memory may support an episode which an individual freely chooses to engage in, while it may suppress an episode which occurs despite an individual's best effort to focus on the primary task. To test this, we conducted a correlational study in which participants first completed a working memory span task and subsequently read three texts. Participants were occasionally interrupted during reading and required to indicate whether or not they were mind wandering. Individuals reporting a mind wandering episode subsequently indicated whether they were voluntarily or involuntarily mind wandering. The relations between mind wandering reports, reading comprehension scores and working memory capacity were then analysed within a mediation model. A negative relation was found between working memory capacity and involuntary mind wandering, while the relation between working memory capacity and voluntary mind wandering was found to be close to zero. Furthermore, only involuntary mind wandering reliably disrupted reading comprehension. We conclude that at least for more complex tasks such as reading, working memory rather acts to suppress mind wandering.

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.. (4714) ..

#### **The fidelity of visual memory for dynamic scenes.**

ROSE WASTLING, DENIS MCKEOWN, CHARITY BROWN, RICHARD ALLEN & DAVID BUNCE; *University of Leeds, United Kingdom*

We report two experiments that explore the fidelity of visual memory for dynamic scenes. The experiments speak to recent debates in the literature on the fidelity of 'dynamic' visual memory and its maintenance over time. Short term memory is well researched for individual static items, but not for dynamically changing visual information, such as natural scenes. Participants viewed short film episodes depicting everyday scenes, followed by a recognition test in which they were presented with selected static frames taken either from those film episodes, or from a different time location within highly similar foil films. The memory test occurred either immediately following film viewing (Experiments 1 and 2) or following a delay period of up to 5 minutes (Experiment 2). Participants performed

above chance in both immediate and delayed tests, but reliably higher in the immediate test. Furthermore, in the immediate test, accuracy was higher for target frames taken from the middle or end of the films compared to the beginning, which is consistent with outcomes for serial order recency effects in visual memory. These findings were replicated across experiments which used different recognition paradigms (a yes/no test in Experiment 1 and a two-alternative forced choice test in Experiment 2). In the delayed testing condition, there were no reliable differences in accuracy according to temporal location of the test frames. The results are interpreted conceptually within an updating memory 'map' or trace preserving recent dynamic visual episodes.

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.. (4715) ..

#### **Does Cognitive Load affect Retroactive Interference?**

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Traditional theories focused on decaying as main reason of forgetting. However, memory research has extensively highlighted the role that interference plays in non-pathological forgetting. According to the notion of interference across different types of post-learning activities, recent studies showed that whatever occurs in a filled delay impairs the retrieval that follows it. Consequently, a wakeful rest (unfilled delay) appears to boost long-term memory in comparison to a period of cognitive stimulation (filled delay). We investigated whether the degree of mental exertion influences forgetting, since the resources available to consolidate recently formed memory traces may be limited. We manipulated the cognitive load of an interfering task by employing, during the retention intervals, an easy tone categorization task, a difficult tone categorization task and a rest phase (unfilled delay). Participants studied a list of 15 words for an immediate recall task, then they either performed the unrelated tone detection tasks or rested in a quiet and dark cubicle. The delay phases lasted 10 minutes each and immediately after the delay, they performed a delayed free recall task. Our results indicated that high cognitive load manipulation impairs delayed recall more than low cognitive load interfering task and rest do. In conclusion, when the interference is kept minimal it does not impair memory traces previously acquired however, a highly demanding interfering task impairs memory.

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.. (4716) ..

**The role of task-relevant perceptual organisation and working memory on children's task performance.** ED D J BERRY, RICHARD J ALLEN & AMANDA H WATERMAN; *University of Leeds, United Kingdom*

Embodied accounts of cognition emphasize the role that the environment plays in influencing and shaping cognitive processes. Here we investigate an application of this approach to supporting children with low working memory ability. Participants were required to remember and recall sequences of colours by placing coloured blocks in the correct serial order. The arrangement of the blocks used for recall was manipulated to be pseudorandom or ordered by colour. Participants in Experiment 2 were also asked to rate the difficulty of the two arrangements, and performed a further condition in which they were given an opportunity to freely arrange the blocks before completing the task. In addition, standard working memory measures were administered. Across both experiments (total N = 166) the task-relevant grouping of the blocks by colour was particularly beneficial to children with low working memory. Individual difference analysis found that scores on simple verbal working memory measures predicted performance on the task. Overall the majority of participants rated an ordered arrangement as easier, although only half of the children with low working memory did so. Furthermore, very few children chose an ordered arrangement when given the opportunity. The implications of this work for supporting children with poor working memory are discussed.  
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.. (4717) ..

**Domain specificity in working memory encoding. An eye-movement study.** STEFAN CZOSCHKE, SEBASTIAN HENSCHKE & ELKE LANGE; *Max-Planck-Institute for empirical Aesthetics, Germany*

The most widely examined distinction of working memory processes is the one between the verbal and spatial domains. While it is well known that both domains rely on different maintenance mechanisms, domain-specific differences in memory encoding processes have been hardly investigated. Previous research has shown that encoding of verbal and spatial material differs in terms of preferred eye-movement patterns. Specifically, verbal encoding is characterized by foveal processing while encoding of spatial material goes along with saccadic suppression. Consequently, the requirement of binding visual and spatial information should introduce a conflict that can be resolved best by maintaining those aspects of eye-movements that are most important for the encoding of the respective material. Here we in-

vestigated conflict resolution under sequential item presentation. Subjects saw five bigrams presented at different spatial positions and subsequently reported the items in serial order. Three recall tasks were employed that demanded to report either one of the features, or both features (combined recall). Mere verbal encoding demands elicited a stronger tendency for item fixations, fewer non-item fixations and fewer regressions (i.e., fixations of previous item positions) than mere spatial encoding. In case of conflict (i.e. combined recall), however, item fixation probability strongly resembled mere verbal encoding behavior without decreasing spatial memory performance. On the other hand, subjects invested additional saccades in the combined condition to approach the number of non-target fixations and regressions seen for mere spatial encoding. We conclude that, while verbal encoding relies primarily on item fixation, spatial encoding requires non-item fixations for memory integration and regressions for maintenance.

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.. (4718) ..

**Direct Gaze Advantage and the Role of Repeated Encounters in Memory for Facial Expressions.** SYLWIA MACINSKA & TJEERD JELLEMA; *University of Hull, United Kingdom*

Background: Facial expressions are among the most important sources of social information, which in combination with gaze direction convey information about behavioural intentions. Faces are multidimensional stimuli, which features must be combined together to form a coherent social meaning; yet memory research has mainly examined the influence of facial expressions and gaze direction separately, largely neglecting interactions between them. Moreover, such studies focus on memory for identity rather than memory for facial expression.

Method: This study examined memory for facial expressions in relation to combinations of emotion and gaze direction. Additionally, the influence of repeated encounters on memory formation (either three or eight) was explored. Participants repeatedly viewed a set of photographs of faces with either happy or angry facial expressions, half of which were presented with direct gaze and the other half with averted gaze. After a brief distraction task, participants were presented with the same set of faces with neutral expression and with the eyes covered, and had to indicate what expression each face displayed during the encounter phase.

Results: Memory for facial expressions was found to increase with the number of repetitions. Overall, memory was better for facial expressions accompanied by direct gaze, regardless of the dis-

played emotion. However, with higher number of repetitions, a clear memory advantage for happy facial expressions was found.

**Discussion:** This pattern of results suggests that the memory for another individual's facial expression partially depends on self-relevance of such expression for the observer. The emotion displayed by that individual seems less important and only comes into play after a certain number of encounters. The findings are discussed in relation to memorising processes in social cognition.

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.. (4719) ..

**Phonological similarity as an index of short term memory precision.** MARION BOUFFIER & STEVE MAJERUS; *University of Liège, Belgium*

The concept of short-term memory (STM) precision has been defined as the resolution with which items are maintained in STM (Joseph et al., 2015). It has to be distinguished from STM capacity, which refers to the number of items that are recalled in a STM task. The latter notion is binary; a stimulus is either recalled or forgotten. On the other hand, the concept of STM precision suggests that items activated in STM may differ with respect to the resolution at which they are represented. The concept of STM precision has been studied in the visual STM domain but has received very little interest in the verbal STM domain. The present study assessed interindividual differences in the sensitivity to different degrees of phonological similarity between memory and probe items as a potential index of verbal STM precision. 60 young adults were presented auditory lists of 6 words. After a delay, a probe was presented, and participants had to decide whether it had been in the list or not. Negative probes showed different degrees of phonological proximity with the target word in the memory list. Using Bayesian repeated measures ANOVA, we observed very strong evidence for an influence of phonological proximity on STM probe recognition performance: the more similar the negative probes to the target word, the higher the rate of false recognition. Critically, at an interindividual level, we observed significant variability in the sensitivity to the phonological proximity of distractors: some participants were very consistently misled by the distractors as a function of phonological proximity, while other participants showed very poor sensitivity to phonological proximity indicating that their memory representations had a low level of phonological resolution. This study suggests that memory-probe phonological similarity is an important variable for the development of measures of STM precision in the verbal domain.

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.. (4720) ..

**Do face adaptation aftereffects extend to alternative categories of natural objects? Evidence from crabs and lobsters.** ANTONIA REINDL<sup>1</sup>, TILO STROBACH<sup>2</sup>, CAROLA BECKER<sup>1</sup>, GERHARD SCHOLTZ<sup>1</sup> & TORSTEN SCHUBERT<sup>1</sup>; <sup>1</sup>*Humboldt-Universität zu Berlin, Germany*; <sup>2</sup>*Medical School Hamburg*

It is commonly assumed that in order to recognize and classify familiar objects, incoming perceptual information is matched against representations of these objects stored memory.

While some theories (e.g., Bruce, 1994) implicitly claimed that these memory representations are stable and accurate, experimental evidence shows that they are flexible and subject to immediate adaptation following exposure to recent perceptual information (e.g., Carbon et al., 2007; Strobach & Carbon, 2013; Webster & MacLeod, 2011). Moreover, adaptation to other, conceptually related visual stimuli can also elicit measurable aftereffects (e.g., Ganis & Shendan, 2008; Ghuman et al., 2010; Cziráki et al., 2010). However, so far, evidence for such flexible representations has largely been limited to human faces.

The purpose of the present study was to test whether adaptation aftereffects extend to visual representations of alternative categories of complex natural objects. In a series of six experiments, the animal categories of crabs and lobsters were examined in adaptation paradigms previously used with human faces.

Interestingly, results show not only robust adaptation aftereffects but also strong priming effects, and only a partial overlap with the pattern observed for human faces. These findings extend the phenomenon of flexible memory representations to complex natural objects, but also indicate the unique nature of human faces in object recognition. Email: antonia.reindl@hu-berlin.de

## Poster Session IV S18, Wednesday, 10:40 – 12:00

.. (4801) ..

**Semantic interference effect for objects and faces in the elderly.** DANIELA PAOLIERI<sup>1</sup>, TERESA BAJO<sup>1</sup> & ALEJANDRA MARFUL<sup>2</sup>; <sup>1</sup>*University of Granada, Spain*; <sup>2</sup>*University of Jaén, Spain*

Name retrieval difficulties during aging have traditionally been explained by a phonological transmission deficit or by an inhibitory deficit. The aim of this study is to explore these two approaches during face and object naming by means of the

semantic blocking paradigm. Two groups of 24 participants (older adults, age range 61-79; young adults, age range 18-24) were asked to repeatedly name objects and famous people in semantically homogeneous and heterogeneous contexts. Event-related brain potentials and naming latencies were measured. Results showed slower naming latencies for face naming compared with object naming, and slower naming latencies in the homogeneous context compared with the heterogeneous context. Moreover, the interaction between type of stimuli and group of participants reached statistical significance, indicating that older adults were more vulnerable to the difficulties generated during face naming. A modulation in the ERP waveforms for both effects was observed in the time windows between 200-450 ms and 500-600 post-target presentation. The theoretical implications of these findings for current theories of naming difficulties during aging are discussed.

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.. (4802) ..

**Reading strategies from second to fourth grade in French children.** VIRGINIE LOISEAU; *University of Clermont-Ferrand-Auvergne-Blaise Pascal LAPSCO, CNRS UMR 6024, France*

Our study focused on the unit for word segmentation in French. We were interested in the use and the role of syllable-sized units in silent reading. Reading level and the initial phonological (syllable) and orthographic frequency (bigrams or trigrams) is known to influence the use of syllable-based strategies. Furthermore, the nature of the task has been shown to modulate the use of the syllable. However, a few studies addressed the issue of how the syllable affects the reading strategies in the time course of acquisition. We tested one hundred and fifty French children from second to fourth grade. We proposed two lexical decision tasks using priming paradigms either with auditory primes (inter-modal), or with printed primes (intra-modal). Both tasks allowed us investigating how the syllable becomes an essential segmental and prelexical unit, by manipulating both the phonological and orthographic frequencies of the initial structure of words. Our main results showed that second graders responded to faster in the inter-modal priming task, while third and fourth graders responded to faster in the intra-modal priming task. The syllable priming effect has been found in third and fourth graders, whatever the task and the phonological or orthographic frequency, while it was restricted to high-frequency segments in second graders. The phonological frequency had inhibitory syllable effects only in fourth graders and facilitatory effects in second and third graders. Sensitivity to orthographic frequency becomes increasingly important

from second to fourth grade. Our results showed that: 1/ there is a progressive increase in the use of the syllable; 2/ a "late" automation of the systematic use of the syllable as segmental and prelexical unit; 3/ the importance of the phonological frequency over the orthographic frequency in the early steps of reading acquisition. We discussed our results towards an interactive activation model with syllable.

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.. (4803) ..

**Individual differences in children's pronoun processing: Reading fluency and rereading behavior are associated with successful mismatch detection.** SARAH EILERS, SIMON P. TIFFIN-RICHARDS & SASCHA SCHROEDER; *Max Planck Institute for Human Development, Germany*

The present experiments aimed to understand processing of mismatching pronouns during reading for comprehension in children at the end of primary school (9-year-olds). Participants read sentences with a gender-matching or a gender-mismatching pronoun in German, while their eye movements were being monitored.

Max{m}/Mia{f} füllte die Schüssel und dann aß er{m} die ganze Suppe.

Max{m}/Mia{f} filled the bowl and then ate he{m} the whole soup.

Max/Mia\* filled the bowl and then he ate all of the soup.

Pronoun processing has been described as a two-part process consisting of (1) connecting the pronoun to an appropriate antecedent, and (2) subsequently integrating the pronoun into the discourse context on the basis of additional context information (Bonding & Resolution; Gerrod and Terras, 2000). In experiment 1, we found no significant difference between adults and 9-year-olds' processing of mismatching pronouns: Both groups showed longer gaze durations and more regressions directly at the mismatching pronoun, paired with more regressions from the final region in mismatch-sentences.

In a replication of the experiment with a larger sample of children (N = 75), we could, however, demonstrate that not all children actually show this adult reading behavior: A subgroup of children had longer gaze durations in the mismatching pronoun region, but did not make more regressions from a mismatching than a matching pronoun. These children were significantly slower during first-pass reading and also performed poorly in a reading fluency test. Their pattern of reading is consistent with disrupted bonding and no subsequent resolution. Importantly, these children were unable to report the detection of a gender mismatch after reading. Children with the more



adult-like reading pattern in contrast reported the detection of a gender mismatch. We discuss these findings with respect to children's reading development and comprehension monitoring during reading.

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.. (4804) ..

**Effects of attraction and word order in correctly produced verb agreement.** MIKEL SANTESTEBAN<sup>1</sup>, ADAM ZAWISZEWSKI<sup>1</sup> & ANNA HATZIDAKI<sup>2</sup>; <sup>1</sup>*University of the Basque Country (UPV/EHU), Spain*; <sup>2</sup>*National and Kapodistrian University of Athens, Greece*

Previous studies that looked at the production of agreement attraction errors showed that verbal agreement is affected by both word order and proximity of other agreeing elements (Santesteban et al., 2013; Haskell & MacDonald, 2005). The current ERP study investigate the timing at which these factors impact correct agreement production in Basque (a verb final language where the verb agrees in number with the subject and the object). Twenty-four Basque speakers participated in a sentence completion task with sentences of canonical-SOV and non-canonical-OSV word order, where the Object-attractor matched or mismatched in number (singular vs. plural) with the singular Subject noun. Sentence preambles were presented word-by-word (RSVP paradigm), and vocal production of the final auxiliary form bearing verbal agreement was required after the verb participle (e.g., Margolari hark pirata bat/hauek marraztu...DU/DITU, "That painter a/these pirate/s drawn...hasSG-OBJ/PL-OBJ"). ERPs and RTs of correct responses were measured.

Results revealed that participants were slower completing SOV than OSV sentences and sentences with plural than singular attractors. ERP results revealed a posterior P2 component between 180-240 ms, with a larger positivity for sentences with plural than singular attractors, but this attraction effect was significant in SOV but not in OSV sentences. A word-order effect related to an anterior negative component was found between 300-400 ms, with a larger negativity for OSV than SOV sentences; this effect was significant in sentences with singular but not plural attractors.

Overall, our study provides novel evidence regarding the timing at which word order and number attraction yield their effects and interact during the production of correct agreement. We tentatively interpret the P2 as difficulty of retrieval of agreement-inflection morphemes during the selection of the agreeing auxiliary verb while the anterior negativity might reflect argument order monitoring processes during the linearization of the in-

flectional morphemes forming the auxiliary verb.

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.. (4805) ..

**Language modulates visual object categorization: Evidence for the whorfian hypothesis in Sign Language.** EDUARDO NAVARRETE<sup>1</sup>, MICHELE MI-  
OZZO<sup>2</sup> & FRANCESCA PERESSOTTI<sup>1</sup>; <sup>1</sup>*University of Padova, Italy*; <sup>2</sup>*New York University, US*

Several studies have collected evidence suggesting that the manner in which we categorize objects is influenced by lexical and grammatical properties of our native language. However, all the existing evidence comes from studies involving oral languages. If the 'language and object categorization' interaction relies on linguistic aspects, this interaction should also be observed in languages that depend on vision for comprehension and hand movements for production, as is the case for sign languages. Here we test the whorfian hypothesis by comparing object categorization in deaf signers of Italian Sign Language (LIS) and hearing native speakers of (oral) Italian. Iconicity in sign languages refers to the property of some signs to resemble features expressed in the object they refer to. We take advantage of iconicity and ask whether visual object categorization in deaf signers is modulated by spatial resemblance to its corresponding sign. We do this by exploring modulations in the electrophysiological index P300 in visual object processing using a visual three-stimulus oddball paradigm (target, standard and rare). Participants do a button-press identification task on the target stimuli. In the critical conditions (standard and rare), the same iconic or non-iconic object is presented with two different spatial orientations. Our results show a greater P300 amplitude between the two spatial orientations for iconic objects in deaf LIS signers compared to hearing Italian speakers. By contrast, P300 amplitude was similar across the two groups of participants for non-iconic objects in which resemblances between the two spatial orientations and the form of the LIS signs were absent. To our knowledge, this is the first demonstration of interaction between visual object categorization and linguistic system in sign languages.

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.. (4806) ..

**Does knowledge of more than one language enhance the ability to learn novel words?** EMILY OXLEY & ANNA WEIGHALL; *University of Leeds, United Kingdom*

Numbers of UK school children classified as having English as an additional language (EAL) has been steadily increasing over the last decade

and an estimated 20.1% of pupils have a first language other than English (DfE & National Statistics, 2016). A gap in attainment between EAL pupils and their monolingual peers is also apparent. For both EALs and monolinguals (ML), vocabulary knowledge is of increasing importance in word reading and text comprehension by mid-primary school (Lindsey, Manis, & Bailey, 2003; Nakamoto, Lindsey, & Manis, 2008). However, there is relatively little research which addresses word learning in children learning English as an additional language. Phonological aspects of word learning have been seen to predict vocabulary growth over time in simulated tasks involving ML children (Gellert and Elbro, 2013). Little is known, however, about whether simulated word learning can predict the vocabulary growth of children who speak more than one language; and evidence is mixed as to whether speaking more than one language confers a language learning advantage (see Bialystok, 2007 for a review). The current study investigates whether speaking more than one language can enhance the ability to learn new vocabulary. Participants were 120 children (60 EAL, 60 ML), aged 7-8 years. The children were taught the phonological and semantic aspects of six novel words in an experimental setting, along with standardised measures of receptive and expressive vocabulary, phonological memory and general cognitive ability. One week later, children were tested on their receptive and expressive knowledge of the novel words. Initial results suggest that both ML and EALs can integrate novel words into their receptive vocabularies after a delay of one week. However, in contrast to ML children, EALs may have a slight advantage when fully integrating novel words into the expressive lexicon.

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.. (4807) ..

**Stutter anticipation in reading.** JOANA CHOLIN<sup>1</sup>, ANNETT B. JORSCHICK<sup>2</sup>, SABRINA HEILER<sup>2</sup>, ALEXANDER WHILLIER<sup>3</sup> & MARTIN SOMMER<sup>3</sup>; <sup>1</sup>Ruhr-University Bochum, Germany; <sup>2</sup>Bielefeld University, Germany; <sup>3</sup>University Medical Center Göttingen, Germany

Adults who stutter (AWS) generally report that they can anticipate upcoming stutter events. Yet, the basis of these stutter anticipations is unclear. The present study investigated whether anticipations are sensitive to inherent linguistic factors or should rather be considered an epiphenomenon of an underlying movement disorder.

We tested the quantity and reliability of anticipations in a group of 21 AWS and matched controls consisting of adults who do not stutter (ANS). Participants read six short stories under two conditions: (1) First, they were asked to read a story

silently and report anticipatory sensations they experienced on individual words. (2) Subsequently, participants were asked to read the same story aloud. Any kind of disfluencies and physical concomitants were transcribed using video-recordings of the overt reading sessions. Stutter anticipations were evaluated against participants' reading fluency and physical concomitants.

Analyses were conducted using log-linear mixed effects models taking participants and words as random factors. Overall, AWS reported significantly more anticipations than ANS. AWS's predictions in the first round were more strongly associated with stuttering events in the second round. Linguistic factors impacted anticipation ratings as well as stutter events: Words appearing in early sentence positions, content words, low-frequency words, and words with lower phonological neighborhood density led to more anticipations. Stutter events, on the other hand, were only influenced by sentence position and word frequency. Other factors implicated in the words' structural make-up were only relevant for individual models of participants (i.e., random effects). Additionally, stutter events that were accompanied by physical concomitants were more likely to be anticipated than stutter events without physical concomitants.

Our results show that AWS were indeed able to predict upcoming stutter events. AWS' predictions take linguistic factors and physical concomitants into account, providing evidence for the relevance of linguistic factors and movement-disorder accounts.

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.. (4808) ..

**The (un)reliability of semantic priming.** TOM HEYMAN<sup>1</sup>, KEITH HUTCHISON<sup>2</sup> & GERT STORMS<sup>1</sup>; <sup>1</sup>University of Leuven, Belgium; <sup>2</sup>Montana State University, USA

Many researchers have tried to predict semantic priming effects using a myriad of variables (e.g., prime-target associative strength, feature overlap, co-occurrence frequency,...). The idea is that relatedness varies across prime-target pairs: "cat" is, for instance, more strongly connected to "dog" than to "animal". This should, in turn, be reflected in the priming effect such that some word pairs should show a larger priming effect than others. However, it only makes sense to predict these item-level priming effects, if they can be measured reliably. In other words, researchers try to predict why "cat" primes "dog" more than it primes "animal" without first establishing that "cat" indeed primes "dog" consistently more. If these item-level priming effects aren't reliable across subjects, then there is in fact nothing to predict. The goal of the present study was exactly to investigate the psychometric properties

of semantic priming. More specifically, we estimated the split-half and test-retest reliability of item-level priming effects under conditions that should discourage the use of strategies (i.e., a short 200 ms SOA, and a low .25 relatedness proportion). The resulting, presumably automatic, priming effects proved to be extremely unreliable. A re-analysis of several published priming datasets from different labs revealed similar cases of low reliability. These results imply that previous attempts to predict semantic priming were not likely to be successful. However, semantic priming is not by definition unreliable. Several factors play a role, but the number of participants over which the average priming effect is calculated, seems particularly important in this respect. One study with an unusually high sample size (for a priming experiment) yielded much more favorable reliability estimates, suggesting that “big data”, in terms of items and participants, should be the future for semantic priming research.

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.. (4809) ..

**The perisylvian language network and language analytical abilities.** OLGA KEPINSKA<sup>1,2</sup>, EGBERT A. J. F. LAKKE<sup>3</sup>, ELEANOR M. DUTTON<sup>1,2</sup>, JOHANNEKE CASPERS<sup>1,2</sup> & NIELS O. SCHILLER<sup>1,2</sup>; <sup>1</sup>*Leiden University Centre for Linguistics, the Netherlands*; <sup>2</sup>*Leiden Institute for Brain and Cognition, the Netherlands*; <sup>3</sup>*Department of Anatomy and Embryology, Leiden University Medical Center, the Netherlands*

Aiming at exploring the brain's structural organisation underlying successful second language (L2) learning, we investigate the anatomy of the perisylvian language network in a group of healthy adults, consisting of participants with high (N = 22) and average (N = 20) language analytical abilities. The two groups were recruited on the basis of a language aptitude test (LLAMA, Meara 2005) administered to a large group of participants (N = 307). Utilising deterministic tractography, six tracts per participant (left and right long direct segment, left and right indirect anterior segment and left and right indirect posterior segment) were virtually dissected and measurements pertaining to their microstructural organisation were collected. Our results obtained by means of linear discriminant analysis pointed to mean diffusivity (MD) values of three tracts (right anterior, left long and left anterior segments) as best discriminating between the two groups. By far the highest coefficient was obtained for the MD values of the right anterior segment, pointing to the role of the right white matter frontoparietal connectivity for superior language learning abilities. Lower MD values were obtained for the highly skilled learners in comparison with the mod-

erately skilled ones. The results imply the importance of attentional processes and reasoning abilities for successful L2 acquisition, and support previous findings concerning right-hemispheric involvement in language learning.

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.. (4810) ..

**Access to emotional word content is not affected by different scripts.** ANNA HATZIDAKI<sup>1</sup> & MIKEL SANTESTEBAN<sup>2</sup>; <sup>1</sup>*National and Kapodistrian University of Athens, Greece*; <sup>2</sup>*University of the Basque Country (UPV/EHU)*

Following emotion and neurolinguistic theories that postulate the existence of a network that contains linguistic as well as emotional information (Bower, 1981; Pulvermüller, 1999), we investigated whether access to these representations is independent of or interacts with orthographic characteristics of words. We employed two alphabetic scripts, Greek and the so-called Greeklish (Roman-character-based script), and examined their effect on the automatic processing of lexicosemantic information of emotional words (Kissler & Herbert, 2013). Sixty Greek native readers took part in a silent reading lexical decision task in which script (Greek vs. Greeklish) and valence (positive vs. negative vs. neutral) were manipulated. Valence differed across the three categories, whereas arousal was the same for positive and negative words, but differed for neutral words ( $p < .05$ ). Words were matched for word class, frequency, length, orthographic neighbourhood, and concreteness. Response latencies were faster for words written in Greek (e.g., *μύκητας* ‘fungus’) than for their counterparts in Greeklish (e.g., *mykitas*): 675 ms vs. 764 ms, respectively;  $p < .05$  (cf. Dimitropoulou et al., 2011). Also, positive words were recognised faster than neutral and negative words (680 ms vs. 724 ms vs. 755 ms), and neutral words were recognised faster than negative words (all  $ps < .05$ ; Estes & Adelman, 2008; Estes & Verges, 2008). The interaction between script and valence was not significant, suggesting equal impact of differential orthographic representations on emotional content activation. Error analysis yielded more errors for negative and neutral words than for positive words (both  $ps < .05$ ). Our results show that positive emotional content accelerates lexical access, whereas negative emotional content slows it down. Importantly, despite the larger cost of mapping orthographic forms onto phonological information in Greeklish, the processor seems to activate lexicosemantic representations of Greek emotional words just as well.

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.. (4811) ..

**Multisensory integration of letters: Beneficial effect of a visuo-haptic training via tactile tablet on letter knowledge and letter handwriting in 5-year-old children.** ARTHUR BOISSON<sup>1,2</sup>, HÉLÈNE LABAT<sup>3</sup>, RÉMY VERSACE<sup>1</sup> & ANNIE MAGNAN<sup>1,2,4</sup>; <sup>1</sup>Laboratoire d'étude des mécanismes cognitifs, Université Lumière Lyon 2, France; <sup>2</sup>LabEx Cortex ANR-11-LABX-0042.; <sup>3</sup>Laboratoire Paragraphe, Université de Cergy-Pontoise, Site de Gennevilliers, Avenue Marcel Paul, 92230 Gennevilliers, France.; <sup>4</sup>Institut Universitaire de France.

Touch-screen tablets can be an effective tool to stimulate learning and are thus increasingly used in the field of education (Goodwin, 2012). Several recent studies have demonstrated the beneficial effect of this support on the reading and handwriting abilities of young pre-readers (for a review, see Ecalle et al., 2017). However, the factors responsible for this benefit remain vague and indistinct. By comparing two touchscreen trainings, one with tactile exploration and the other without, this research aims to study the training of the graphomotor processes underlying letter knowledge.

Thirty-three 5-year-old children were tested before and after training on 2 tasks: a letter recognition task and a letter handwriting task. The children were trained targeting 8 letters (ie, p/b, t/d, k/g, f/v). They performed a visuo-auditory-haptic (VAH condition) exploration on half the letters and a visuo-auditory (VA condition) exploration on the other half of the letters. In the letter handwriting task, many measures are analyzed: kinematic aspects of writing (duration, speed, pauses, ductus etc.) as well as qualitative aspects (form and size of the letters) judged by the a posteriori replay of children production. The analyses are currently in process: we predict a higher performance gain for the VAH letters. This benefit would indicate that the addition of an haptic experience would favor both the development of handwriting skills but also the memorization and assimilation of grapho-phonemic correspondences. Using the Act-In model as a theoretical support, a situated and embodied model of memory (Versace et al., 2014), we hypothesize that this beneficial effect would be explained by the mechanism of integration, a mechanism allowing the processing of multiple dimensions relating to an object or an event.

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.. (4812) ..

**The Intention to Voice a Phrase Modulates the Activity of the Articulatory Musculature during Listening or Reading.** NAAMA ZUR<sup>1,2</sup>, AVI KARNI<sup>1,3</sup> & ZOHAR EVIATAR<sup>1,2</sup>; <sup>1</sup>University of Haifa, Israel; <sup>2</sup>Institute of Information Processing and Decision Making; <sup>3</sup>Edmond J. Safra Brain Research Center for the Study of Learning Disabilities

The articulation of a given speech sound is often contingent on the intention to produce subsequent sounds (co-articulation). Thus, intended acts affect the way current acts are executed. Here we show that the intention to subsequently repeat a short sentence, overtly or covertly, significantly modulated the articulatory musculature already during listening or reading (i.e., during the input phase). Young adults were instructed to read or listen to recordings of sentences so as to repeat them afterwards. Surface electro-myography (sEMG) recordings showed a significant reduction in articulatory muscle activity, in the orbicularis oris inferior and the thyrohyoides muscles, compared to baseline, during the input phase. These reductions in sEMG activity were contingent on the intention to subsequently overtly repeat the input, as well as on the input modality. Only auditory input but not reading resulted in significant reductions in sEMG activities also when participants intended to repeat the sentences covertly. Neurolinguistic models suggest that language perception and articulation interact, the current results suggest that the interaction begins already during the input phase, listening and reading, and reflects the intended responses.

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.. (4813) ..

**The gender congruency effect in Catalan-Spanish bilinguals: Evidences from the translation recognition task.** MARC GUASCH<sup>1</sup>, PILAR FERRE<sup>1</sup>, JOSEP DEMESTRE<sup>1</sup>, TERESA BAJO<sup>2</sup> & DANIELA PAOLIERI<sup>2</sup>; <sup>1</sup>Department of Psychology and CRAMC, Universitat Rovira i Virgili; <sup>2</sup>Department of Experimental Psychology, Mind, Brain and Behavior Research Center, (CIMCYC), Universidad de Granada

The importance of grammatical gender in bilingual production has been evidenced by means of different paradigms and distinct bilingual populations, but the evidence is less robust in word recognition. In this study we evaluated whether lexical access in each of the bilingual's language (either L1 or L2) is modulated by the grammatical gender of the words in the other language. To this end, two groups of Catalan-Spanish bilinguals performed a translation-recognition task from Spanish to Catalan and from Catalan to Spanish while the congruency of the grammatical gender between their two languages was manipulated. Catalan

and Spanish are Romance languages, with very similar gender systems in terms of gender values and gender agreement, but to date no evidence of grammatical gender effects has been firmly established in either production or comprehension. In the translation-recognition task, participants were presented with Catalan and Spanish pairs of words and had to decide if they were translation equivalents. The correct translations included Catalan and Spanish words that were grammatical gender congruent (*l'estiu/el verano* – summer) or grammatical gender incongruent (*la tardor/el otoño* – street). Reaction times and accuracy were measured. The results showed congruency effects in both measures: Participants were faster and more accurate in the gender congruent condition relative to the incongruent condition. The facilitative effect of gender congruency observed in this study suggests that the bilingual's two gender systems interact, even in highly proficient bilinguals. The grammatical gender effect found in both translation directions is discussed in terms of current models of bilingual memory.

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.. (4814) ..

**Modelling the structure and dynamics of semantic processing.** ARMAND STEFAN ROTARU<sup>1</sup>, STEFAN FRANK<sup>2</sup> & GABRIELLA VIGLIOCCO<sup>1</sup>; <sup>1</sup>*Division of Psychology and Language Sciences, University College London, London, United Kingdom*; <sup>2</sup>*Centre for Language Studies, Radboud University, Nijmegen, Netherlands*

**Background:** The contents and structure of semantic memory have been the focus of much recent research, with major advances in the development of distributional models, which use word co-occurrence information as a window into the semantics of language. However, these models do not account for the dynamics of activation. Here, we examined whether a processing model of semantics, based on spreading activation, can account for behavioural results in a number of semantic tasks, beyond what can be explained using a purely structural model.

**Method:** Starting from the continuous bag-of-words distributional model, trained over the British National Corpus, we allowed activation to spread throughout the resulting semantic network, as dictated by the patterns of semantic similarity between words, and recorded the activation of each word, as a function of time. We then employed the resulting Markov chain to study how the activation pattern at each time point relates to task performance in lexical and semantic decision, concreteness and imageability rating, as well as similarity/relatedness rating.

**Results:** For all the tasks, our processing model

accounted for a significant amount of variance not predicted by a purely structural model. The largest improvement was found for tasks where semantics plays a central role (e.g., semantic decision) as opposed to tasks for which semantics is of secondary importance (e.g., lexical decision).

**Discussion:** Our results indicate that bringing together distributional semantic networks and spreading of activation provides a good fit to both automatic lexical processing (as indexed by lexical and semantic decisions) as well as more deliberate processing (as indexed by ratings), above and beyond what has been reported for previous models that take into account only network structure.

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.. (4815) ..

**Dynamic scope of planning sentence production in L1 and L2.** TORU HITOMI & ROBERT H. HART-SUIKER; *Ghent University, Belgium*

Cognitive mechanisms of disadvantages in second language (L2) speech production have been explained by some accounts yet still under debate. We focus on how much speakers plan their sentence production ahead of initiating articulation, called planning scope. The planning scope has been claimed to vary depending on the cognitive load of tasks at hand. In the present study, assuming the higher cognitive demand for L2 production, we examined whether the size of planning scope becomes smaller in L2 than in L1 in two experiments adopting the cross-modal semantic interference paradigm. Furthermore, we attempted to identify factors modulating the interference effect by running mixed-effects multiple regression analyses because the influential factors may indicate the possible locus of L2 disadvantages. Dutch-English proficient yet unbalanced bilinguals were required to produce sentences in a fixed syntactic structure using names of two visually presented line-drawings. Naming language was a within-subject blocked factor. Semantic interference was manipulated by presenting an auditory distractor that was semantically related to the first noun, the second noun or neither of them to estimate the size of planning scope. We regarded the semantic interference as the lexical activation before speech onset. In both experiments, the second noun seemed not activated and there was no significant interaction between naming language and semantic relatedness. Our hypothesis that planning scope in L2 is smaller than in L1 was therefore not supported. Separate analyses for each language investigating the effects of covariates on RT, however, revealed that lexical frequency of the second noun was consistently interacted with the semantic relatedness condition. These results suggest that there seem to be no disadvantage in L2 sentence production with

regard to the planning scope size and the planning scope is dynamically adjusted depending on contexts regardless of language.

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.. (4816) ..

### **Investigating the nature of morphological errors in deep dyslexia: The case of prefixed words.**

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**Background:** The reading performance of deep dyslexic individuals is characterized by the production of morphological errors (Rastle et al., 2006). These involve the single constituents of morphologically complex words, suggesting decompositional rather than full-form storage. While most neuropsychological studies investigated suffixed words, only a few involved prefixed words (e.g. Semenza et al., 2002). The present study specifically investigated the production of morphological errors with prefixed words.

**Method:** NN, a German 64-year-old man with deep dyslexia, participated in two reading experiments. In experiment 1, we compared errors with prefixes and suffixes; items were simple words or words containing a prefix and a suffix (Verarmung 'impoverishment'). Experiment 2 investigated the nature of morphological errors with prefixed words; items were prefixed or pseudo-prefixed words (Insekt 'insect': prefix in-, Sekt 'sparkling wine'), words with embedded stems (Barock 'baroque': Rock 'skirt'), or with embedded prefixes (Gepard 'cheetah': prefix ge-).

**Results:** In experiment 1, NN correctly produced more simple than derived words (32%, 18%;  $\chi=9.211$ ,  $p=.002$ ). When the stem was preserved, prefixes and suffixes were comparably affected (accuracy: 47.6%, 40.5%). Prefixes were omitted in 20.5% and substituted in 79.5% of the cases, while suffixes were always substituted ( $\chi=8.660$ ,  $p=.003$ ). In experiment 2, NN's accuracy was similar across conditions; the amount of constituent errors was comparably large for the prefixed and the pseudo-prefixed items (64.3% and 70%; embedded stem: 37.5%; embedded prefix: 42.9%). Finally, prefixes in prefixed words were always omitted, but only omitted in 22.2% of the cases in pseudo-prefixed words ( $\chi=6.741$ ,  $p=.009$ ).

**Discussion:** The study investigated morphological errors with prefixed words. Experiment 1 found a different error pattern for prefixes and suffixes, in terms of error type. Experiment 2 found differences between errors with prefixed and

pseudo-prefixed words or words with embedded stems or prefixes, suggesting that morphological errors with prefixed words are truly morphological.

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.. (4817) ..

### **Seeing a duck when hearing a rooster's crow – Semantic interference from pictures in sound naming tasks.** STEFAN WÖHNER, JÖRG D. JESCHENIAK & ANDREAS MÄDEBACH; *Leipzig University, Germany*

The picture-word interference task is a prominent tool to investigate speech production processes. One important finding is the semantic interference effect: participants name target pictures (e.g., rooster) more slowly when presented with semantically related distractor words (e.g., duck) compared to unrelated distractor words (e.g., doorbell). The functional interpretation of this effect has been a matter of debate, which revolves to a large degree around the question whether or not this effect is restricted to specific task-configurations (e.g., picture naming in the context of distractor words). Previous studies suggest that semantic interference is independent of distractor word modality (Damian & Martin, 1999) and also obtained with distractors other than words (Mädebach, Wöhner, Kieseler, & Jescheniak, 2017). In the present study, we investigated whether semantic interference is also independent of target modality by using environmental sounds instead of pictures as targets. Sounds (e.g., crowing of a rooster) were presented with distractor pictures which were either conceptually identical (e.g., rooster), semantically related (e.g., duck) or unrelated (e.g., doorbell) to the target sound. We observed facilitation from conceptually identical distractor pictures and interference from semantically related pictures, each in comparison to unrelated pictures. We replicated this pattern in a dual-task experiment in which the sound naming task always followed a simple visual discrimination task. The dual-task results suggest that the semantic interference effect of distractor pictures in sound naming arises during response-selection. The experiments demonstrate the feasibility of using sound targets in chronometric studies of speech production. Most importantly, our results suggest that semantic interference effects are not restricted to specific task-configurations, as they arise also with target sounds (and distractor pictures). This supports models attributing semantic interference effects to general semantic-lexical selection processes in speech production (e.g., Levelt, Roelofs & Meyer, 1999).

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