

**PROCEEDINGS OF THE  
SIXTH CONFERENCE OF THE  
EUROPEAN SOCIETY FOR  
COGNITIVE PSYCHOLOGY**  
Summaries

**Edited by  
Claus Bundesen  
Axel Larsen**

*ESCP*

Proceedings of the Sixth Conference of the  
European Society for Cognitive Psychology:  
Summaries

Edited by Claus Bundesen and Axel Larsen

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## Preface

This book contains summaries of all papers presented at the Sixth Conference of the European Society for Cognitive Psychology (Elsinore, Denmark, September 11-15, 1993). The Programme Committee for the conference consisted of Carlo Umiltà (President of the Society), Philip T. Smith (Secretary of the Society), and Claus Bundesen (member of the Executive Committee of the Society). The Organizing Committee consisted of Claus Bundesen (Organizer), Axel Larsen (Co-Organizer), and Hitomi Shibuya.

The first chapter of the book contains summaries of the two invited presentations: the Opening Address by Charles W. Eriksen and the Invited Lecture by Ulric Neisser. Chapter 2 contains summaries of the regular papers. These are grouped by content. Chapter 3 consists of the proceedings of the symposium on "Visual selective attention" (convened by Hitomi Shibuya) and the symposium on "General architectures of cognition" (convened by Josef Krems). Chapter 4 contains summaries of the poster presentations in alphabetical order by the surname of the first author. At the end of the book is an author index.

Most of the papers presented at the conference are authored by European scientists, and the book provides an overview of the state of the art in cognitive psychology in Europe. In our opinion, European cognitive psychology is more vigorous than ever. Major steps have been taken to synthesize the rich diversity of national traditions found in Europe as well as absorbing and contributing to the scientific development in North America. The resulting interplay of ideas has yielded remarkable progress.

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The following publishing companies supported the conference by participating and providing material: Prentice Hall, Inc.; Elsevier Science Pub-

lishers; The MIT Press; John Wiley & Sons, Ltd.; Open University Press; and Lawrence Erlbaum Associates, Ltd.

Important practical assistance in organizing the conference was provided by staff and students at the University of Copenhagen, in particular, Vibeke Andersen (secretary), Lejf Rasmussen (engineer), Anne Lindholm Nielsen (technician), Kristján Jul Houmann, Søren Kyllingsbæk, and Rune Møller Jensen.

*Claus Bundesen*  
*Axel Larsen*

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## Chapter 1

# Invited Presentations

### 1.0.1 Opening Address:

**The flankers task and response competition: A useful tool for investigating a variety of cognitive problems**

*C. W. Eriksen, University of Illinois, USA*

Research has shown that the reaction time interference produced by the flankers task arises from the incipient activation of competing responses. The response competition paradigm has made valuable contributions to evaluating continuous flow versus discrete stage models of information processing as well as understanding cortical evoked potentials. The paradigm has been used to map the visual attentional field as a function of task demands and has also been found useful in the study of memory. It offers promise in studies of cognitive categorization and has provided insights into the "fast same effect" on same-different judgments on comparison tasks. It is currently being applied to the study of disjunctive comparisons.

### 1.0.2 Invited Lecture:

**The ecological and social roots of cognition**

*U. Neisser, Emory University, Atlanta, USA*

Recent findings show that cognitive processes are both more innate and more culturally based than we used to think; they are also more diverse. On the one hand ecological and interpersonal perception are both innately prepared, available in early infancy; on the other hand intellectual development is critically dependent on social support. Taken together with

the emerging multiple/modular structure of the brain, these discoveries demand a new kind of cognitive theory: an ecologically grounded account of the development and interaction of a number of distinct cognitive systems. Three such systems will be described: direct perception/action, interpersonal perception/reactivity, and recognition/representation.

Direct perception/action, as originally described by J.J. Gibson, is based on invariant information structures like those in the optic array. Based chiefly on motion-produced information, it enables accurate perception of the layout of the local environment and its affordances. Clearly in place by three or four months of age, it establishes an immediate non-representational sense of self and environment that "grounds" all other forms of cognition.

Interpersonal perception/reactivity is present from birth. Based on species-specific patterns of action and reaction, it establishes ongoing dialogues in which both participants perceive each other as intentional agents. Typically accompanied by rich affect, it defines both self and other as social beings.

Where both of the other systems are concerned with the present state of affairs, recognition/representation concerns relations between present and past: it identifies and classifies what is perceived. There are many recognition sub-systems, some primitive and others very sophisticated. The neuroanatomical "where/what" distinction shows that the brain mechanisms of direct perception/action are distinct from those of recognition/representation.

These three systems begin to cooperate near the end of the first year, in the social learning situation of "joint attention." Directly or indirectly, this situation underlies the acquisition of language and most other forms of cultural learning.

## Chapter 2

# Regular Papers

## 2.1 Visual Perception

### 2.1.1 The time-course of adaptation to auditory-visual spatial discrepancy

*P. Bertelson, Université Libre de Bruxelles, Belgium*

Earlier work has shown that attending to synchronous but spatially separated trains of light flashes and noise pulses produced adaptive shifts in both visual and auditory localization. The present experiment was run to obtain a detailed picture of the time course of those shifts. It was based on a new experimental paradigm, in which short blocks ( $N = 12$ ) of bisensory conflict trials with the same spatial discrepancy were followed by "erasure" bisensory trials with visual and auditory stimuli originating in the same location. The calibration states of both the visual and the auditory localization processes were monitored continuously by having each bisensory adaptation trial followed immediately by a unisensory test in which the subject pointed with the unseen finger to the perceived location of alternatively visual and auditory stimuli. Blocks of adaptation trials were run with angular discrepancies ranging from 5 to 20 deg, in both directions (sound left/right of light). In the auditory modality, pointing showed an extremely fast adaptation, reaching an asymptote after 4 to 6 exposure trials. Erasure was still faster, since 2 erasure trials brought pointing back to the baseline level. The same asymptotic level (about 3 deg) was observed for discrepancies from 10 to 20 deg. In the visual modality, no adaptation whatever was observed. It would seem that visual adaptation, which was observed after longer exposures (Radeau & Bertelson, 1974, 1976), is a slower phenomenon

than auditory adaptation.

### 2.1.2 The spatial anisotropies in the efficiency of detecting element displacement in the context of dotted visual structures

*T. Bachmann, Tallinn Pedagogical University, Estonia*

Subjects performed the task of detecting the displacement of a dot either along the main axis of a visual dotted structure (curved line) or orthogonal to it. Various exposure durations were also employed. The results indicated that the orthogonal offset was considerably harder to detect with short versus long exposures, however it was still easier to detect than the equidistant displacement along the main axis of the dotted curve across most of the durations used. Over ten theoretical explanations of this result are offered in order to illustrate how uncertain we would be in our theorizing unless we turn to psychophysiological explanations as based on the definite knowledge of the functioning principles of the underlying neural processing mechanisms.

### 2.1.3 Identifying degraded stimuli – Evidence for analytical processes?

*S. A. Los, Free University, Amsterdam, The Netherlands*

Two main views on the way we identify objects are analytical and nonanalytical generalization (Jacoby and Brooks, 1984). Analytical generalization is an information reducing ability to relate an actual experience to abstractions represented in a semantic network. Nonanalytical generalization is an ability to relate an actual experience as a whole to comparable earlier experiences stored as separate instances in memory.

Van Duren and Sanders (1984) found evidence for analytical identification of degraded stimuli. They presented subjects with stimuli that were either intact or degraded by noise in pure and mixed blocks of trials. Their main result was that intact stimuli were faster responded to when presented in pure blocks than when presented in mixed blocks, whereas this difference was virtually absent for degraded stimuli. From this result Sanders and Van Duren inferred the presence of distinct processing routes for intact and degraded stimuli: a slow route for degraded stimuli, comprising an analytical clean-up process, and a nonanalytical fast route for intact stimuli, bypassing the clean-up process. In pure blocks the optimal route can be selected for either stimulus quality, but in mixed blocks attention is focussed on

the “worst case”, that is on degraded stimuli, causing intact stimuli to be partially processed along the slow route, thus delaying their identification.

The present study aimed at testing this model versus more general alternatives that do not assume structural differences in processing stimuli of different stimulus qualities. For this purpose, stimuli of various distinctive visual qualities were pairwise entered in the pure-mixed design to establish the necessary and sufficient conditions that yield the effect observed by Van Duren and Sanders. The theoretical implications of the results are discussed.

### 2.1.4 An adaptive pandemonium of templates for visual pattern recognition

*A. Larsen and C. Bundesen, University of Copenhagen, Denmark*

Two classical approaches to visual pattern recognition: template matching and feature analysis, are combined in a single system in which feature analysis is done by template matching. The degrees of match obtained by template matching are signalled to conceptual nodes, each of which computes a weighted sum of its inputs. The perceptual classification is based on the node at which the weighted evidence is highest.

The system was trained to recognize unconstrained handwritten digits. The feature analyzers were built during the first pass through the training set: Whenever an input character was misclassified, the input pattern was stored as a template in a new feature analyzer. The analyzer was connected to the correct conceptual node with a high positive weight and to other conceptual nodes with small negative weights. During later passes through the training set, the weights on the connections from feature analyzers to conceptual nodes were adjusted by the least-mean-square rule.

The system was tested on a new set of unconstrained handwritten digits. The mean rate of recognition was 95.3%. This is somewhat lower than human performance, but comparable to performance by the most complex and successful machine algorithms designed specifically for recognition of handwritten digits.

### 2.1.5 Perceptual preference for one of two categories as a function of the number of their items

*Y. Kareev and J. Avrahami, The Hebrew University of Jerusalem, Israel*

This paper deals with the question whether perceptual preference for one of two unequally sized categories will be affected by the number of items in each. In three experiments the subjects' task was to indicate the two categories into which they would classify a group of items. Items were generally similar but fell naturally into two categories. The sizes of the two categories, the complexity of their items and (in the third experiment) the age of the subjects were varied. Results showed that when the size of both categories was within STM, subjects first pointed at the items of the bigger category; when the size of the smaller category was within STM but that of the bigger outside STM, subjects first pointed at the smaller category; when the size of both categories was outside STM, there was a slight tendency to point at the smaller category first. Critical category size decreased with age and with growing complexity of the stimuli, lending further support to the hypothesis that perceptual preferences were guided by memory capacity limitations. A fourth experiment examined whether the perceptual preferences uncovered by the first experiments would affect performance in an attribution task. Subjects attributed a personality trait to one of two unequally sized categories of creature-like stimuli. Four traits, of different frequency and value, were employed. Results paralleled those of the first experiments: When both categories were within STM, subjects attributed the trait – be it rude, original, stable or unoriginal – to the items of the bigger category; when only the smaller category was within STM, subjects attributed the trait to the items of that category. It should be noted that these results are contrary to predictions of psychodynamic theory and to those of illusory correlation.

### 2.1.6 Do we need a phonological code for the processing of visual stimuli?

*M. Brysbaert and G. d'Ydewalle, Katholieke Universiteit Leuven, Belgium*

It has been claimed that visual stimuli are translated into a phonological code for further processing. Part of the argument is based on the finding that subjects look longer at visual drawings that represent things with a long name than at drawings that represent things with a short name. The best known example is the syllable length effect in number processing:

Persons look longer at numbers with a long name than at numbers with a short name. In Gielen, Brysbaert, and Dhondt (1991) we have shown that this is only true when the numbers have to be said aloud after the encoding, and not when the numbers are to be compared with one another. The present experiments extend this finding, and look what happens when the subjects are confronted with a root memory task without verbal reactions.

## 2.2 Visual Attention

### 2.2.1 Moving from location to location? Shifting visual attention across the visual field

*J. Müsseler, Max-Planck-Institute for Psychological Research, Munich, Germany*

The *spotlight metaphor* claims that while attention moves in the visual field, stimulus information in the attended spot is processed in an accentuated, prioritized manner. This implies further assumptions about the course of focusing. For example, it is assumed that the focus of attention is of a certain size which does not change during a shift, that the attentional focus moves with a continuous speed, or that the locations the focus passes over are to a certain degree attended as well. In the last few years some of these implications have been criticized more and more.

In this contribution we will concentrate on another implication of the metaphor, namely that attention moves from location to location, from one object in the visual field to the other. On the basis of prior findings (Müsseler & Neumann, 1992) we developed an alternative conception: It maintains that in the case of onset-triggered processes the attentional shifts always originate in the foveal areas or that the fovea is at least the preferred reference point. This idea claims the *position invariance* of attentional shifts. We refer to attention's functional relation to eye movements and to the fact that internal focusing is independent of physical constraints. A related idea is also implied in the so-called *premotor theory of attention* (Rizzolatti et al., 1987; Umiltà et al., 1991). Starting from these considerations, experiments will be described that include cueing of different peripheral positions of the visual field. The results will serve to test the alternative conceptions against each other.

### 2.2.2 The effects of visibility and attention on visual search

*M. Donk, Free University, Amsterdam, The Netherlands*

Most theorists on visual search and attention make a distinction between parallel and serial processing. Whether a target between distractors can be found in parallel or whether it requires a serial attentional scan, is generally inferred from functions relating the mean reaction time (RT) to the number of elements in the display. An increasing search function is then taken as evidence for serial search, whereas a flat search function is assumed to indicate parallel search. The major assumption of such an inference is that increasing the number of elements in a display does not affect the visibility of the target. In the present study it was investigated to what extent target-visibility affects the RT in a typical feature search and absence search task. Earlier experiments have shown that feature search generally results in a flat search function whereas absence search can be described by an increasing search function. This was also found in the present experiment. However, the results suggest that differences between feature and absence search are the result of differences in visibility instead of processing mode.

### 2.2.3 Object-based orienting of attention

*C. Umiltà, U. Castiello, and M. Fontana, Università di Padova, Italy*

A central controversy in current research on spatial attention is whether attention is directed to unstructured regions of space or to perceptual groups that produce salient objects. A closely related issue concerns the coordinate system(s) in which spatial attention operates. Typically, a distinction is made between egocentric coordinates and object-centered coordinates.

In the present experiment, the subjects were presented with a Necker cube on a computer screen. The Necker cube is a line drawing with 2 possible solutions in depth perception and both are interpreted as a 3-dimensional object. In Condition 1, the cube was seen as a static object in the center of the screen. The subjects' attention was directed by a visual cue to an angle at a vertex of the cube. After 500 ms, the imperative stimulus was presented at the cued location (valid trials) or at an uncued location (invalid trials). Valid trials occurred 70% of the time, whereas invalid trials occurred 30% of the time. The subjects were required to signal detection of the imperative stimulus by pressing a key on the computer keyboard (simple RT). RT for valid trials (433 ms) was significantly faster than RT for invalid trials (478 ms). RT for invalid trials did not depend on whether

the imperative stimulus was presented in the same plane as the cue (479 ms) or in a different plane (477 ms).

Condition 2 was identical to Condition 1, except for the fact that the cube was seen as a rotating object in the center of the screen. Because of this experimental manipulation, the cue directed attention to a location that moved in the egocentric space, whereas it did not move in the object-centered space. In other words, as the cube rotated, the cued location came to occupy different positions in space even though the local feature of the object that had been cued (i.e., a given angle at a given vertex) remained the same. It was reasoned that if attention operated in egocentric coordinates, the validity effect should disappear. In contrast, if attention operated in object-centered coordinates, the validity effect should still be present. RT for valid trials (430 ms) was significantly faster than RT for invalid trials (498 ms). The validity effect was significantly greater with the rotating object of Condition 2 (68 ms) than with the static object of Condition 1 (45 ms). It was concluded that the results supported object-based models of spatial attention.

### 2.2.4 Spatial attention and the Simon effect

*R. Nicoletti, Università di Modena, and C. Umiltà, Università di Padova, Italy*

The Simon effect occurs when a nonspatial stimulus attribute indicates the position of the response. Even though the spatial position of the stimulus is not task relevant, it affects response speed. We propose that attention orienting toward the imperative stimulus produces the stimulus spatial code, which in turn causes the Simon effect. This hypothesis makes 2 predictions. The first is that the stimulus spatial codes should be formed with relation to the current position of attention. The second prediction is that the Simon effect should not manifest itself when attention orienting is prevented.

In Experiment 1, the subjects were required to perform a shape discrimination task by pressing one of 2 keys, located to the left and right of the body midline. Six empty boxes marked the possible stimulus positions. A small solid square marked the position where the subjects were to direct attention on each trial, whereas fixation did not move. The results showed a Simon effect attributable to the position of the stimulus in relation to where attention had been directed on a given trial. In contrast, there was no Simon effect attributable to either the body midline or fixation. These findings supported the first prediction.

In Experiment 2, the subjects were presented with a display similar to that of Experiment 1, but they were not instructed to move attention. On



each trial, a letter appeared for 100 ms below fixation, simultaneously with the imperative stimulus. One of the letters signaled a catch trial, in which the subjects had to refrain from responding to the imperative stimulus. It was reasoned that this experimental manipulation prevented attention from orienting toward the imperative stimulus. No Simon effect could be observed.

Experiment 3 was identical to Experiment 2, except for the fact that the letters were presented 500 ms before the imperative stimulus. It was reasoned that now the subjects could discriminate the letters at fixation and then move attention toward the imperative stimulus. A clear-cut Simon effect was found. Therefore, Experiments 2 and 3 supported the second prediction by showing that orienting of attention toward the imperative stimulus is necessary for the Simon effect to occur.

### 2.2.5 Effects of visual angle and exposure duration of stimuli on processing dominance

*D. Luna, M. Ruiz, and J. M. Merino, Universidad Nacional de Educación a Distancia, Madrid, Spain*

The size and exposure duration of stimuli have been found relevant factors to the issue of processing dominance. Nevertheless, the relation between these two factors and their possible effects on processing dominance have never been studied. The aim of the present research was twofold: First, to examine whether the size and the exposure duration of stimuli affect processing dominance. Second, to examine whether these effects depend on the same/different eccentricity of global and local levels.

Stimuli were presented at three exposure durations: 140 msec, 70 msec, and 40 msec. The overall visual angle of stimuli were varied at three levels: small (3 deg), intermediate (6 deg), and large (12 deg). In the first experiment we used stimuli whose global and local levels were at different eccentricity (characters H and S). In the second experiment we used stimuli whose global and local levels were at the same eccentricity (character C). The relevance of the present results to the issue of processing dominance will be discussed.

### 2.2.6 Selective attention as an effect of motor planning

*M. Ziessler, Humboldt-University Berlin, Germany*

Usually effects of selective attention are considered to be the result of expectations concerning some features of the forthcoming stimulus. Correct expectations accelerate the identification of the stimulus. Wrong expecta-

tions slow it down. In many approaches a separate mechanism is assumed to be responsible for the control of attention. In line with Neumann (1987) we suppose that attention control is embedded in the process of motor planning. Following this view we assume that the encoding of new information will be accelerated, if its identity or the position or time of its appearance can be anticipated in the context of an active action planning.

In the experiments one group of subjects (experimental group) had to respond to four different stimuli (letters W, F, S, X) with four response buttons. The stimuli were presented at varying positions within a 5x5-display of irrelevant letters. The subjects had to respond to the relevant stimulus as quickly as possible. Each response triggered the presentation of the next stimulus, which required the next response. This chain of stimuli and responses was stopped by a fifth stimulus connected with an additional response (V). The length of the stimulus-response chains was variable (3-9). For all trials there was a systematic relationship between the identity of a stimulus and the position of the next one. If the given stimulus was a W, the next stimulus appeared above the given position, if it was an S below. Following an F the position of the next stimulus was left of the given position, following an X it was right. The subjects were trained over three sessions of two hours each. In the last block the relations between the identity of stimuli and the next relative positions were changed.

A second group of subjects (control group) trained with the same sequence of stimuli and the same rule of relative positions. But there were only two different responses: One response for the stimuli within the chain (W, S, F, X) and one response for the last stimulus (V).

The results show that only the subjects of the experimental group made use of the relationship between the stimulus identity and the next position to anticipate the forthcoming stimulus. Only in this case the change of the relations in the last block caused longer reaction times and a higher variance, whereas for the control group the reaction times and variances remained unchanged.

It is argued that the systematic relationship between the stimulus identity and the next position can be recognized much better if it has been mediated by different responses. It is the active planning of responses which connects the given stimulus with the next position. Under the conditions of the experimental group the four relative positions are the sensory consequences of four different responses to four different stimuli. Contrary, for the control group the relationship between the stimuli and the positions may be lost because there is only one response mediating between them.

## 2.3 Time, Rhythm, and Movement

### 2.3.1 The role of attention in prospective duration estimation

*D. Zakay, M. Ahavia, and I. Elkayam, Tel-Aviv University, Israel*

The role of attention in prospective time estimation was explored. It was hypothesized that the more attention is allocated for temporal information processing, the higher are prospective duration estimates. Two experiments were conducted. In the first experiment, auditory stimuli were subjected to a procedure for producing conditioned inattention. Prospective estimates of exposure durations of these stimuli were longer after such a procedure than when the stimuli were presented without being so conditioned. In the second experiment, prospective duration estimates were highest when time estimation was treated as a primary task and the to be estimated interval was filled with a simple secondary task, and shortest when time estimation was treated as a secondary task, and the primary task filling the interval was complex. In both experiments, the temporal structure of the events filling the estimated time interval, the number of presented stimuli, and responses were kept constant. These results supported the tested hypothesis and were accounted for by an attentional model of prospective time estimation. However, the question of whether temporal and nontemporal information processing compete for limited resources, or whether attention allocated for temporal information processing is a product of an allocation policy as such, remains open.

### 2.3.2 The cognitive timer-model for time estimation – New evidence

*J. Glicksohn, Tel Aviv University and The Open University of Israel*

Zakay, Nitzan, and Glicksohn (1983) postulated the existence of a cognitive timer (i.e., internal clock) whose purpose is to process and encode temporal information, utilizing attentional resources for this function. As nontemporal information load is reduced, more attentional resources may be allocated to the timer. Thus, time estimation is directly related to the amount of attention allocated to the passage of time, and inversely related to the amount of attention required for concurrent nontemporal information processing.

In the studies reported here, the baseline rate of functioning of this cognitive timer was investigated. The approach adopted was to extend this

cognitive-timer model in an attempt to bridge between cognitive and neurobiological notions of temporal functioning. It is assumed that the amount of attentional resources allocated to the timer is determined, in part, by the level of arousal of the organism. Thus the cognitive timer, as internal clock, will speed up or slow down its baseline rate of functioning as arousal level is altered, irrespective (to a degree) of particular attentional demands imposed by concurrent information processing. The primary task of interest is one of estimating short time intervals ranging between 4 and 32 seconds via the method of production, within a prospective paradigm. A second method employed is that of retrospectively estimating (verbally) the duration of the experimental session.

In the first study reported here (Glicksohn, 1992), the relationship between prior exposure to an altered sensory environment and subsequent time estimation was investigated. The working hypothesis of this study was that the more varied the sensory environment, the faster would be the rate of functioning of the cognitive timer. It was found that visual and auditory stimulation interacted in their production of an altered sensory environment. Underload in both modalities produced a situation of perceptual deprivation, resulting in a slower rate of functioning of the cognitive timer. When overload in one modality was coupled with underload in the other, the cognitive timer was found to run at a faster pace.

In the second study reported here (Glicksohn, Mourad, & Pavell, 1991-92), we investigated the potential influence of trait in determining the baseline rate of functioning of the timer. We assumed that the influence of trait would be in the determination of the degree of attention required for nontemporal information processing. We predicted that high absorption subjects as opposed to low absorption subjects would get engrossed in their nontemporal processing. As a result, less attention would be allocated to temporal processing. They would therefore tend to underestimate the duration during which they completed various tasks. In addition, a significant difference for the two groups on the time production task would indicate a significant difference in rate of functioning of the timer, irrespective (to a certain degree) of nontemporal processing. It was found that the high absorption subjects found our tasks tapping imagination to be relatively less demanding and more interesting than did low absorption subjects. In addition, high absorption subjects provided relatively longer estimates for the production task, indicating a slower baseline rate of functioning of the cognitive timer.

In the third study, both prior exposure to an altered sensory environment and the subject's absorption level were found to result in a trait-context interaction in determining the rate of functioning of the cognitive timer.

I present and discuss these studies, and attempt to draw implications regarding both the cognitive-timer model and a contextualistic approach to time perception.

### 2.3.3 Prediction of time series by human subjects in natural settings and the laboratory

*M. Dubois and G. Lories, Université Catholique de Louvain, Belgium*

Bolger and Harvey (1992) show that human subjects produce positively autocorrelated predictions for time series whether those series are positively or negatively autocorrelated. He attributes this result to their using an anchor and adjust strategy. The authors results are reproduced in Experiment 1. The anchor and adjust heuristic presents well-known shortcomings that also show up in Bolger and Harveys results. Nevertheless it is possible that in more realistic conditions, using series that have a more or less complex natural structure and especially when external information is given, the anchoring part of the heuristic takes care of most of the prediction problem. Experiment 2 investigates the effect of providing external information on the anchor and adjust strategy and its accuracy. Data regarding human behaviour on this type of problem in more natural (industrial) settings are also provided and discussed.

### 2.3.4 Sleep deprivation, body temperature, cognition, and performance

*H. Babkoff, Bar-Ilan University, Ramat-Gan, Israel*

Correlating performance with body temperature, generated under the same conditions of sleep deprivation, is an important means of testing for endogenous sources of rhythmicity and for clarifying the nature of the hypothesized oscillator. Examples are given of several performance tasks and body temperature generated in a 72 hour sleep deprivation experiment. The data are analyzed by Complex Demodulation into monotonic and rhythmic components. Evidence is presented that although correlating raw performance and temperature data may yield low or non-significant results, the underlying circadian rhythms may be highly significantly correlated. This procedure leads to the conclusion that certain performance rhythms and temperature may share the same generating oscillators.

### 2.3.5 Force coupling in two-handed oscillating movements: A transient phenomenon?

*W. A. C. Spijkers and H. Heuer, Universität Dortmund, Germany*

The inability to perform different forces for both hands simultaneously which has been found in studies using repetitive movement tasks, indicates that force control for the two arms is not independent. Because the same force parameter is apparently applied, the hands are said to be coupled in this respect. However, force coupling seems not to be the general mode of control in two hand coordination tasks. Evidence for independent force control has been found in discrete movement tasks. These discrepant findings suggested to us that force coupling is likely to be a transient phenomenon and related to the time available for preparation of the movement. The question how force coupling is related to preparation time was addressed in two experiments. Subjects' task was to perform symmetrical sinusoidal movements with both arms simultaneously. The movements were lateral arm displacements from the median plane away and back. They were carried out on two digitizer tablets, one for each arm. Several movement combinations were examined in which the movement amplitude for the two arms was either similar, dissimilar, or alternating in size. In the first experiment a trial consisted of ten consecutive movement repetitions, while in Experiment 2 only one discrete amplitude pair was executed in each trial. The time to prepare on the varying force demands during movement execution was varied by gradually increasing the movement speed in Experiment 1, whereas in the second experiment this was realized by changing the length of the interval between warning and imperative signal. The main finding was that with sufficient preparation time before movement execution (Experiment 2) or with sufficient time for on-line adjustment during movement execution (Experiment 1), different amplitudes could be performed for both hands simultaneously. This independent control of the force parameters of both hands gradually changed into coupling as in Experiment 1, where repetitive performance was required, speed of movement execution increased. This clearly supports an interpretation of force coupling as a transient phenomenon. The implications of these findings for motor program theories and notions of central oscillators will be discussed.

## 2.4 Similarity Scaling

### 2.4.1 Resemblance between letters in visual processing *G. Leunbach, The Danish Institute for Educational Research, Copenhagen, and J. Petersen, The Royal Danish School of Educational Studies and University of Copenhagen, Denmark*

Several series of experiments were performed as a part of a study of different stages of the reading process in children. In the tachistoscopic test situation the subject has to look at the target-stimulus followed by a stimulus-item and subsequently to answer nonverbally whether the stimuli match in a prescribed way. The probabilistic analysis has a parameter for each target stimulus in the situation where Match is the correct response; it may have different parameters for different Non-Match test pictures. One series contained letters in unusual positions, mirrored or upside down, as target pictures, and letters in normal positions or numbers as distractors, and the criterion for the choice of distractors has mainly been geometric similarity, for instance *j* as test picture for *f* upside down or *4* for *h* upside down, but in some presentations of the same target pictures *f* and *h* in normal position have been used, and this has given some very striking results: *4* as a distractor for *h* upside down has given only a few errors, but *h* has given many wrong Match answers; *h* as a distractor for *h* in a mirrored position, *s* for mirrored *s* and *m* for *m* upside down likewise. The results for *f* and *j* are contradictory. These results seem to reflect a conflict between the given task and immediate recognition of letters even in unusual positions.

### 2.4.2 Common and distinctive features of similarity and preference judgments

*I. Gati, The Hebrew University of Jerusalem, Israel*

Previous research revealed that the stimulus structures derived from similarity and preference data are similar but not identical. We assumed that the differences in the structures reflect systematic and predictable differences in the processes involved in making similarity and preference judgments. Specifically, relying on Tversky's (1977) contrast model, we hypothesized that the relative weight of common vs. distinctive features will be higher in similarity than in preference judgments. Using occupational titles as stimuli, we elicited from each of 60 subjects his or her alternatives-by-attributes matrix. These data were used to predict the same individuals' judgments of similarity between the occupations and their preferences towards these

occupations. Using within-subject analysis, the individuals' occupations-by-attributes matrix accounted for 30% of the variance of their similarity judgments, and 43% of the variance of their preference judgments. As hypothesized, the relative weight of common vs. distinctive attributes was higher in similarity than in preference judgments ( $t(59) = 3.19, p < .01$ ). Some of the attributes were found to predict both judgments, whereas others contributed only to similarity or only to preference judgments. These findings are discussed in relation to the various factors which affect the relative weight of common and distinctive features in the comparison between stimuli.

### 2.4.3 Cluster-analysis of nonverbal judgments of schematic facial expressions

*G. V. Paramoy, Moscow State University, Russia, and Ruhr-Universität Bochum, Germany*

Computer generated schematic faces differing by constant physical amounts of mouth curvature and eyebrows slant were considered as analogies to the natural facial expressions. Both variables were set up with several angle gradations either positive or negative. The total number of stimuli which were presented as hard copies resulted in all pairwise combinations of mouth curvature and eyebrows slant.

In the present study it was questioned if schematic facial configurations, being potential candidates for a human-computer dialogue, could be perceived as conveying emotions and could be categorized in accordance with the so-called basic emotions. Another question concerned the relation between the quantitatively described facial variables and the corresponding emotional categories.

Few previous researches on schematic facial expressions have used either verbal scales, discrimination task, or nonverbal multidimensional techniques. In this study an alternative procedure to the methods so far used was tested. Data from a "free-grouping" task were analysed by a clustering method (the nearest neighbour and the furthest neighbour). Such an approach is congruent with the assumption that the response to facial expressions is in terms of similarity between items within categories.

The principal disjoint clusters obtained are considered as prototypical. Their names were chosen in accordance with the traditional lists of basic emotions, on one hand, and with the quantitative measurements of the two changing variables, on the other, namely: Anger; distress; sadness + fear; joy (happiness); compassion; interest; surprise. When the stimuli within each cluster were related to the quantitative measures of two variables, more

detailed information could be extracted: The angle gradations of mouth curvature and eyebrows slant could either amplify each other or interact in a subtractive mode, after a rule of "signs addition".

Thus hierarchical cluster analysis reveals the interaction between facial features composing a kind of gestalts. Schematic faces, though void of individual peculiarities, wrinkles and topological differences, appear to communicate categorized emotional meanings.

## 2.5 Learning

### 2.5.1 Do we have the learning theories we need?

*J. Hoffmann, University of Bundeswehr, Munich, Germany*

Psychological learning theories should be able to explain how human beings do improve their intentional behavior, i.e. how they evaluate their experiences to achieve increasingly distinguished aims. Successful intentional behavior implies, first that the initial conditions are taken into account, and secondly that the to be expected outcomes are anticipated. What has to be learned, one can conclude, are systematic interrelations between initial conditions, behavioral acts, and their respective outcomes.

Traditional learning theories mostly concern relations between only two of these three components of an intentional act: reflex theories can be regarded as analyzing the formation of associations between initial conditions and outcomes, instrumental conditioning concerns associations between initial conditions and acts, and learning of expectancies concerns contingencies between acts and their outcomes.

Edward C. Tolman (1932) was one of the first learning theorists who claimed that all three components have to be considered. Organisms do not learn, he argued, how to REact on given stimuli but how to act under given circumstances in order to achieve some goal. Other theorists followed. Rescorla and Wagner (1972) emphasized that organisms only learn if events violate their expectations. Bolles (1972) thought about a synthesis of S-S and R-S expectancies, and Holyoak, Koh, and Nisbett (1989) recently proposed "S-S,R" rules which are modified by learning.

A tentative learning mechanism will be introduced which (hopefully) integrates the central ideas of the aforementioned theories into a unique structure: abstractions and differentiations are driven by comparisons between real and anticipated outcomes. The merits and deficits of the proposed structure as well as possibilities for its improvement are discussed.

### 2.5.2 Knowledge and category learning

*A. Vandierendonck, University of Ghent, Belgium*

Recently, exemplar approaches to category learning have been rather successful in generating accurate predictions about transfer and typicality gradients. On the other hand, it is still believed that theories about the world, implicit cognitive models, and the like play an important role in processes of categorization and in maintaining a stable view of the world. According to exemplar models, e.g., whales and dolphins should be categorized as fish, while most of us categorize them as mammals, because of our specific knowledge of the relationship between these animals and the category of the mammals.

Research on how theoretical knowledge affects categorization behavior and how it affects the processes of category learning and transfer has been rather scarce. Experimental data concerning this relationship are presented. Subjects learned to categorize fictive creatures, either without or with different types of knowledge about these creature. An overview of the results will be presented and discussed within the context of the relationship between exemplar models and "implicit theory" models of category learning.

### 2.5.3 Mutual transfer between perception and action in the learning of spatiotemporal patterns: Common coding or current coupling?

*S. Vogt, Max-Planck-Institute for Psychological Research, Munich, Germany, H. Hecht, NASA Ames Research Center, Moffett Field, California, USA, and W. Prinz, Max-Planck-Institute for Psychological Research, Munich, Germany*

Transfer of training represents a paradigmatic field of research for studying relationships between perceptual and motor processes. While transfer from perception to action has, under labels such as movement imitation or observational learning, found at least moderate interest in the areas of movement science, social learning, and the sport sciences, transfer from action to perception clearly is an underresearched area.

This paper reports two experiments dealing primarily with action-perception transfer and two experiments dealing exclusively with perception-action transfer. The first experiment aimed at an empirical evaluation of action-perception transfer in a spatiotemporal event discrimination task, where the criterion task was to estimate the relative duration of two successive sine wave movements presented on an analog display. The

relative durations varied within the range of 50% to 200%. Prior to this criterion task, a pretraining was given which involved the active production of such movements by two successive extension-flexion movements with feedback about the actual timing. This pretraining turned out to be about equally efficient for the performance in the criterion task as a pretraining in the criterion task itself with similar feedback, and superior to a pretraining in an irrelevant discrimination task. A second experiment, currently carried out, attempts to rule out a possible alternative interpretation of this result in terms of an intermodal transfer by studying the relative efficiency of an active vs. passive movement pretraining. That is, we wanted to know if the intention to produce a particular relative duration is crucial, or if an evaluation of kinesthetic feedback is sufficient for the transfer.

In the second set of experiments, the learning of complex cyclical movement sequences was studied in an observational learning paradigm. Both experiments provide evidence that a repeated visual demonstration is sufficient for an accurate reproduction of the movement form and, more surprisingly, also for improvements in the temporal consistency of movement, normally described as a consequence of extended physical practice. Thus, in some form, the results of the perceptual processing during the demonstration phase turned out to be immediately effective during the physical production of the pattern and did not require additional translatory processing. - At present, we are exploring two variants of theoretical explanation for both sorts of transfer: The first is in terms of an abstract representational medium for the coding of perceived and performed events (common coding, Prinz, 1990, 1992; Neisser, 1985), the second is in terms of a current (continuous) coupling between perceptual and motor processes during event perception itself, - a kind of "motor theory of event perception". According to this second view, motor or enactive processes play an integrated role in perception itself, they are "always there".

#### 2.5.4 Effects of practice on coordination of mental transformations of patterns

*H. Hagendorf, Berlin Humboldt University, Germany*

Coordinative activities have been proposed as important in research on individual differences (Baddeley, 1990; Just & Carpenter, 1991). Efficiency in managing memory and accessing the next step in a cognitive procedure seems to be the key to skilled performance in a variety of cognitive tasks. Our aim was to investigate the impact of practice on skill for coordinating mental transformations and to examine transfer of practiced skills to novel tasks (Schmidt & Bjork, 1992).

The main task required subjects to indicate whether symbolically suggested transformation rules correctly describe the differences between two patterns of filled-in-squares within a  $3 \times 3$  matrix (Mayr & Kliegl, 1992). The patterns could be rotated and/or reflected. Three experiments were carried out: (1) Subjects participated in 8 blocks of 24 trials to investigate the practice effect on coordinative activities. (2) A second experiment was aimed at analyzing the transfer of practiced skills on new patterns of comparable complexity. (3) In a further experiment we analyzed the transfer on tasks with a new set of transformations.

Analysis which is not yet finished focused on times for encoding and transformation of patterns, and the comparison times. The following result will be presented and discussed: (1) Coordination complexity (Kliegl & Mayr, 1992) has a nonlinear effect on transformation time suggesting that a great deal of time is spent on processes other than executing the transformations. (2) With practice subjects execute the transformations more rapidly. The efficiency gain lies mostly in managing memory. (3) Performance on the two transfer tasks indicated that the practiced skill did not generalize under the conditions of our experiments. This result is more consistent with instance-based theories of practice (Kluwe & Haider, 1992).

Taken together, the nonlinear effects were consistent with the expectation that additional processing requirements become necessary for coordinating spatial transformations. Power-law practice functions are currently used to analyze practice curves in dependence on complexity. We will consider the implication for further research on transfer in connection with working memory tasks in nonverbal domains and therefore outline a conceptualization about how to practice for transfer.

#### 2.5.5 Processing structured event sequences

*D. Nattkemper, Max-Planck-Institute for Psychological Research, and W. Prinz, Ludwig-Maximilians-University, Munich, Germany*

Our paper is a contribution to the understanding of how subjects (organisms) learn to exploit structures of their environment. In the experiments letters were shown in a sequence which was either random or predictable. In random sequences, the sequence of letters was generated by a random number generator. Predictable sequences were generated by determining that a given symbol was succeeded by one specific letter (deterministic sequence) or by one of two specific symbols (partially predictable sequence). The subjects' task was to indicate the identity of a given letter by pressing a corresponding response button. If one asks subjects participating in such



experiments, they usually are neither able to report that different types of letter sequences were presented nor do they realize that some of the sequences contained regularities. Nevertheless, there was a clear facilitative effect of predictability: Reaction time decreased with increasing predictability of the letter sequences.

This pattern of results raises the further question what subjects learn when processing structured event sequences. One possibility is that they learn the sequence of stimulus events. Alternatively, subjects may learn sequences of motor responses in this task. A decision between these alternative views was expected from experiments which had two major features: (1) As compared to the number of stimulus alternatives (8 different letters) the number of response alternatives was reduced (4 different response buttons each of which corresponded to two of the letters). (2) We occasionally inserted individual letters in the sequence of stimulus events, which deviated from the regularities of the particular sequence. Under these circumstances it is possible to generate deviations from the stimulus event regularities which do or do not violate the sequence of motor responses. The data speak in favor of the motor view of sequence learning: Reaction time costs were only observed when irregular stimulus events were associated with irregular motor responses.

### 2.5.6 Attention and explicit knowledge in sequence learning

*A. Cleeremans, Université Libre de Bruxelles, Belgium*

How does implicit learning interact with the availability of explicit information? In a recent series of experiments, Curran and Keele (1993) demonstrated that sequence learning in a choice reaction setting involves at least two different processes, that result in differing availability of the acquired knowledge to conscious inspection, and that are differentially affected by the availability of attentional resources. In this paper, I propose a new information-processing model of sequence learning and explore how well it can account for these data. The model is based on the Simple Recurrent Network (Elman, 1990; Cleeremans and McClelland, 1991; Cleeremans, in press), which it extends by allowing explicit information to modulate processing. The model implements the notion that awareness of sequence structure changes the task from one of anticipating the next event based on temporal context to one of retrieving the next event from short-term memory. This latter process is sensitive to the availability of attentional resources. When the latter are available, performance is enhanced. However, reliance on representations that depend on attentional resources also

results in serious performance degradation when these representations become less reliable, as when a secondary task is performed concurrently with the sequence learning task. The model is also useful in understanding how other variables, such as stimulus complexity or task demands, interact with implicit learning performance.

### 2.5.7 About neural networks and the inverse base rate effect

*G. Lories, Université Catholique de Louvain, Belgium*

While several demonstrations of the inverse base rate effect have been published (Medin & Edelson, 1988; Shanks, 1992), the effect is not well explained by the most successful models of categorisation (e.g., Hintzman, 1986; Gluck & Bower, 1988; Kruschke, 1991; Nosofsky, Kruschke, & McKinley, 1992). The effect is puzzling because it is apparently not adaptive and presents a difficult challenge for several neural network models (Gluck & Bower, 1988; Markman, 1989; Shanks, 1992; Gluck, 1992). The most common neural network models are shown not to be appropriate for simulating the effect with the exception of Anderson's BSB model that does show the inverse base rate effect in some simple cases. These difficulties suggest that the inverse base rate effect may not stem from a fundamental property of the categorisation learning mechanism usually described but from a higher level response strategy. Data from experiments in which the subjects are prevented from explicitly formulating hypotheses are presented and discussed.

## 2.6 Memory

### 2.6.1 To image or not to image? That is the question

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T. Porter, University of North Carolina at Greensboro,  
USA*

Two of the most robust findings in cognitive psychology are the concreteness effect and the imagery effect. Although quite consistent in published works, we have demonstrated that these effects can be attenuated or eliminated in essentially any memory paradigm. In several previous studies, we showed that concreteness effects depend on the joint functioning of relational information and the distinctive information provided by imagery (or other item-specific strategies). Those demonstrations, however, have entailed indirect manipulations of relational processing, with or without explicit

instructions to use mental imagery in incidental memory tasks. In the present experiments, we crossed item-specific and relational instructions with instructions to use imagery or verbal strategies under intentional memory instructions. Subjective reports of strategy use also were obtained. The results strongly support the relational-distinctive explanation of concreteness effects and rule out any alternative that explains concreteness and imagery effects solely in terms of multiple memory codes. Such results constrain theoretical explanations of the role of imagery in memory and cognition and suggest the need to re-examine some long-held beliefs about imagery.

### 2.6.2 Ordinal recall in spatial mental models

*T. S. Baguley, The Open University, Milton Keynes, UK*

The structure of a spatial mental model (SMM) corresponds to the situation described by texts or spoken language rather than the language itself. When people recall spatial descriptions their drawing orders are strongly correlated with the order of the description. The order of mental model construction has been proposed as an explanation of this drawing order effect. However, the order of mental model construction and the order of the text are usually confounded. In two experiments the drawing order effect is replicated and extended to new situations. In order to look at the effects of text order and mental model construction separately both "unscrambled" and "scrambled" texts (where sections of the story were presented in a random order) were presented. In Experiment 1 overall recall for the scrambled story was poor and no drawing order effect was obtained. However, the probability that an item was recalled was consistent with the order of mental model construction. In Experiment 2 recall for the scrambled stories was high and a drawing order effect consistent with the construction of a SMM was obtained. These findings are discussed in relation to text and mental model based accounts of ordinal recall for spatial descriptions.

### 2.6.3 Release from verbal overshadowing (RVO effect)

*M. A. Brandimonte, University of Trieste, Italy, J. W. Schooler, University of Pittsburg, USA, and P. Gabbino, University of Trieste, Italy*

Schooler and Engstler-Schooler (1990) demonstrated that overt verbalization subsequent to encoding a visual input interferes with the recollection of the original visual memories (Verbal Overshadowing). Most recently, Brandimonte and Gerbino (1993) have shown that verbal overshadowing

can also occur as a consequence of covert verbal recoding of the visual input at the time of initial learning. One important assumption is that the verbal overshadowing effect reflects a kind of recoding interference that does not eradicate the original visual memories, but makes them temporarily inaccessible. If so, one might expect that, under appropriate conditions, verbal overshadowing may be alleviated, hence allowing the use of the original visual information. Initial support for such a hypothesis comes from the study by Schooler and Engstler-Schooler (1990, Experiment 6). However, no systematic attempt has been made so far to investigate this issue.

The present research is aimed at exploring whether spontaneous and/or induced verbal overshadowing can be eliminated by using a visual retrieval cue (e.g., color) which was encoded at the time of initial learning. Two experiments were carried out in which subjects learned either easy or hard-to-name pictures which were drawn on colored cards. Then, they were asked to mentally rotate each picture in order to discover two joined capital letters (see Brandimonte, Hitch, & Bishop, 1992). In each condition, half the subjects were shown the color of the background on which each picture was drawn just before performing the mental rotation task, while half were directly required to perform the task. In the first experiment, easy and hard-to-name pictures were used. From previous studies we knew that easily nameable pictures tend to be spontaneously recoded into a verbal format. However, if the original visual information is simply overshadowed by the verbal one, re-presentation of the color in which each picture was initially learned could make it accessible, hence improving performance in the imagery task. No such an effect should be expected in the hard-to-name picture condition which should be as good with as without color re-presentation. Results confirmed our predictions in showing an interaction between nameability and presence of the retrieval cue. In another experiment, verbal overshadowing was experimentally induced by supplying verbal labels to the hard-to-name pictures. The retrieval cue had the effect of improving performance in the imagery task only in presence of labels. Without labels, performance was as good with as without color re-presentation. This effect, which we termed "release from verbal overshadowing" (the RVO), demonstrates that visual information which has undergone verbal recoding at the time of input is simply "unaccessible", not definitively "lost" (cf., e.g., Bahrich & Boucher, 1968).

### 2.6.4 Articulatory loop and stuttering

*H.-G. Bosshardt, Ruhr-Universität Bochum, Germany*

On the background of results from earlier investigations it was hypothesized that stutterers subvocalize more slowly than nonstutterers. More spe-



cifically, it was assumed that (1) stutterers have a lower short-term serial recall performance than nonstutterers, (2) this difference between the two groups is more pronounced for long than for short words, and (3) under articulatory suppression both the differences between the two groups and between the long and short words become insignificant. These expectations were tested in a short-term serial recall experiment similar to that of Baddeley, Thomson and Buchanan (1975). 14 adult male stutterers and 19 adult male nonstutterers matched for age, education, and verbal intelligence participated in the experiment. Two pools of 10 nouns each were produced, one of short words (one syllable), and one of long words (three or four syllables), matched for category membership and for word frequency. From each pool, 12 five-word lists were constructed by sampling randomly without replacement. Word length and articulatory suppression were factorially varied in a within-subject design. Half of each set of 12 lists was studied with the subjects remaining silent and the other half with the subjects counting repeatedly from one to eight during presentation (articulatory suppression). The words were visually presented at a 1.5-sec rate on a computer display. Contrary to the expectations, the recall performance of the two groups was not significantly different, nor were the interactions between groups and word length and between groups and suppression. But a significant three-way interaction between group, suppression and serial position was found. Under articulatory suppression the stutterers had a lower primacy effect than the nonstutters. These results show that the articulatory loop system is not the main determinant of differences in the short-term recall of stutterers and nonstutterers. The results of the present experiment can be interpreted by the assumption that the two groups differ with respect to nonphonological forms of coding. This assumption is presently tested in further experiments.

### 2.6.5 How to get context effects with action memory

*T. Helstrup, University of Bergen, Norway*

Action memory has been found to deviate from nonmotor memories in a number of ways: no level of processing effect, no age differences, no rate of presentation effect, no primacy effect – and no context effect. Research evidence from a wide range of experiments is briefly outlined, demonstrating that context effects often are absent in memory of subject performed tasks. Evidence from new experiments is then discussed. These experiments suggest that whether context effects will be present or not depends on the use of item-specific or whole-list relational contexts. Also the evidence indicates that the presence of action goals pertains to whether context effects will appear. The issue of context effects is discussed in terms of theories that

assume the existence of partially independent motor memory subsystems, and in terms of theories that try to do without appeal to separate motor stores.

### 2.6.6 The retention of order information in action memory

*U. Olofsson, University of Umeå, Sweden*

The effect of enactment on serial recall was examined. The subjects studied lists of verbal- and subject-performed tasks and were required to recall the items in the same order as they had been presented. After the final serial recall attempt, a free recall test was given. There was as expected a strong effect of enactment on final free recall. On serial recall the subjects produced significantly more items in the right order – but they also produced more items in the wrong order. When overall performance was adjusted for, by dividing the number of items recalled in order by the total number of items recalled, then serial recall was found to be slightly worse in the enactment condition. The results thus suggest that enactment does not give rise to the kind of relational processing that would facilitate the retention of order information.

### 2.6.7 Differentiated effects of integrity level of items on cued recall and free recall tests and on enacted and nonenacted events

*R. K. Nouri, University of Umeå, Sweden*

Most memory research carried out since the end of the 19th century has been concerned with remembering of verbal events. Recently, a promising attempt has been made to extend this verbal learning approach to memory of action events. The typical result in such experiments is that recall is higher after action encoding than after encoding without actions.

The present study was designed to uncover differentiated performance of cued and free recall on one hand, and of enacted and nonenacted events on the other hand, in terms of well and poorly integrated items. The results show dissociative patterns of superiority of memory performance. In well integrated items, the performance of cued recall is superior to the performance of free recall. However, in poorly integrated items, there is a superiority of free recall over cued recall performance. Furthermore, the performance of verbal tasks is deteriorated more than enacted tasks from well integrated to poorly integrated items and from free recall to cued recall. The results are discussed in terms of integrity (association) level of items.

### 2.6.8 Remembering arbitrarily generated security codes

*K. A. Ohlsson and K. W. Sandberg, Luleå University of Technology, Sweden*

A practical aspect of everyday memory is the sometimes severe recollection of personal security codes adhered to a number of credit cards, security cards etc. An increasing but frequently intermittent use of these codes puts high demands on memory capacity. The present study investigates some of the strategies employed by the man in the street. Also a series of laboratory experiments on the remembering of security codes under different conditions will be reported. Finally, computer simulations of a limited set of alternative designs of user interfaces facilitating the remembering of security codes will be presented. The results will be discussed in terms of multimodal information processing and parallel processing.

### 2.6.9 Automatic and active search processes in eyewitness memory: The Cognitive Interview revisited

*J. Jackson, NISCALE, Leiden, The Netherlands*

Whilst research has shown that frequently the key factor in solving a criminal case is the completeness and accuracy of eyewitnesses, other research has pointed out that witness reports tend to be incomplete, inaccurate and easy to influence. Moreover, police officers receive little formal training in the use of effective interviewing techniques. One way of resolving this dilemma has been suggested and researched by Geiselman and colleagues: It involves training interviewers in a scientifically based interviewing method that is based on four explicit retrieval mnemonics.

While this method (called Cognitive Interview Technique) is claimed to be both efficient and effective with subjects recalling more correct and producing fewer incorrect responses than with traditional methods, and has in fact had a large impact on investigating techniques in the US, the evidence supporting the claims are still somewhat diverse.

The particular explicit mnemonic strategy which will be discussed in this paper relates to "context reinstatement". The theoretical rationale underlying this choice is the encoding specificity principle of Tulving and Thompson: with context reinstatement being viewed as providing extra cues for retrieval by reinstating features present at the time of the original encoding.

The instructions used by the Geiselman group require the subjects to reinstate in their mind the context surrounding the incident. This includes

the environment, the weather, any people or objects that were around as well as thoughts about their feelings and reactions at the time of the incident. They then report what they can remember. Any questions asked by the detectives are in the past tense, e.g., what did you do then? I would liken this strategy to an action replay in which subjects try to mentally reconstruct their feeling and sequences of actions.

The context reinstatement or guided memory technique which is at present being taught to Dutch police officers resembles a mental walk strategy. Subjects are asked to imagine an instance that occurred prior to the target incident, they should try to make this image as clear as possible and then, in the present tense, relive the event from that moment. Questions posed by the interviewer are always in the present tense, e.g. what is happening now?

An experiment comparing witness reports derived from each of these techniques as well as from a standard interview will be described and the results will be discussed in relation to the activities that go on in trying to recollect, namely an active search process and a more involuntary or automatic process whereby information pops up as if from nowhere.

### 2.6.10 Relationship between prospective memory and discrimination of relative recency

*J. Cockburn, McDonnell-Pew Centre for Cognitive Neuroscience and Rivermead Rehabilitation Centre, Oxford, UK*

The ability to remember prospectively is important in everyday life. However, in addition to the memory-for-content component of prospective memory, which shares common processes with retrospective recall and recognition memory, other skills are essential to carrying out any activity at the right time and place.

This paper investigates the hypothesis that the temporal element in prospective memory is related to discrimination of relative recency of presentation of material in retrospective memory, and that it may be, to some extent, independent of recognition memory.

Two studies are presented that compare performance of young and old volunteer subjects, and brain-injured patients with documented everyday memory impairment, on measures of time-based and event-based prospective memory, recognition memory and discrimination of relative recency.

Study 1 identified a significant difference between scores of patients and control subjects on a time-based prospective memory task, and on

verbal recency discrimination but not verbal recognition memory. There were no significant differences between young and old volunteers. Scores on prospective memory and verbal recency measures were weakly correlated but the relationship was stronger than with recognition memory. Although the differences were not significant, there was a trend for people failing both parts of the prospective memory task to have the lowest recency scores and those succeeding in both to have the highest, whereas there was no comparable difference in mean recognition memory scores.

Study 2 compared performance on a list discrimination task with performance on a time-based and an event-based prospective memory task. Results showed a negative correlation between prospective memory and recognition and a positive but small correlation with discrimination. There was a significant difference in list discrimination scores between those failing both prospective tasks and those passing both.

However, although the results of both studies suggest that prospective memory may be more strongly related to recency discrimination than to recognition memory, analysis has been complicated by problems of ceiling effects on the prospective memory tasks, especially among volunteer subjects.

Constraints imposed by the laboratory setting on testing prospective memory, and the need for ensuring comparable levels of difficulty of prospective and retrospective memory measures are discussed in the light of these findings.

### 2.6.11 The week schema in memory for event dates

*S. F. Larsen, University of Aarhus, Denmark, and C. P. Thompson, Kansas State University, USA*

Memory for the time of events is mainly reconstructive, relying on a variety of temporal schemata at different levels. Recent studies indicate that schematic knowledge of the temporal structure of the days of the week exerts a strong influence on the dating of autobiographical event memories. We present data from a diary study that show this day-of-week effect to be largely independent of retention time, as would be expected for a schema-based process. The results suggest that even when public news events are dated, the week schema is concerned with regularities inherent to the autobiographical content of memories. The structure of the week schema does not seem to be reducible to the social convention of a 5+2 cycle (i.e., weekdays plus weekend).

### 2.6.12 Conceptual priming of scripts

*S. Samuelsson and J. Rönnerberg, Linköping University, Sweden*

Four experiments compared implicit and explicit measures of retention as a function of conceptually primed scripted representations. Implicit memory was assessed by a lipreading task, and explicit memory by a free recall task. In Experiment 1, no priming effects were obtained when the priming task emphasized pure data-driven perceptual processing. However, when conceptually driven processing was emphasized, the overall priming effect across Experiments 2 to 4 was 10%. The results also revealed that the magnitude of priming was 15% for atypical and specific scripted representations, and strong dependencies between lipreading and recall were obtained. The priming effect across experiments for typical and basic scripted representations was 6%, and independence between the measures was found. Finally, there were larger priming effects with semantic than with auditory encoding for both lipreading and recall. The levels of processing effect was, however, larger for recall, and even more marked for atypical and specific representations. These results suggest that both data-driven and conceptually driven implicit memory functions need to be refined by focusing more on pre-existing memory representations. A framework will be suggested where typical and basic representations are assumed to possess a semantic state of accessibility, insensitive to episodic modifications. On the other hand, atypical and specific representations are assumed to possess an episodic state of accessibility, sensitive to episodic modifications. Finally, implications for contemporary accounts of implicit and explicit measures of retention will be considered.

### 2.6.13 The relationship between explicit and implicit memory

*G. Wolters, Leiden University, The Netherlands*

It is becoming increasingly clear that many variables once thought to influence only explicit memory affect implicit memory performance as well. Examples of such variables are "levels of processing", massed versus spaced repetition, and amount of attention. Some new experimental data showing both similar and dissimilar effects of experimental manipulations on explicit and implicit memory performance will be presented.

Such findings are highly relevant for the question what distinguishes implicit and explicit memory. The general answer, of course, is that implicit and explicit memory tasks apparently address common elements in

structures and/or processes involved in implicit and explicit expressions of memory. The occasional presence or absence of dissociations is often explained in terms of study-test compatibility. Although this is an important explanatory concept, we will argue that an additional concept is needed, namely automatic versus controlled processing. We will present a theoretical framework combining these concepts.

According to this framework stimulus encoding causes changes in a unitary, but modularly structured, memory system. Modules are interconnected subsystems specialized in the representation of particular aspects of information. Changes consist of the strengthening of already existing representations (activated either automatically or by controlled processing) and the formation of new interitem and item-context associations (created only by controlled processing). Controlled processing is a prerequisite for explicit memory, but it can also influence implicit memory performance. In contrast, automatic processing will affect implicit memory only.

From this asymmetry it follows that consistent dissociations will occur when controlled processing is absent (i.e., when stimuli are completely unattended) or when controlled processing, and its subsidiary process of creating new associations, is defective (as may be the case in anterograde amnesic patients). Whether or not dissociations will occur following controlled processing in normal subjects will depend upon the compatibility of what was encoded and the information present during retrieval.

#### 2.6.14 Measures of memory, age, and conscious awareness following implicit and explicit word association tasks

*R. I. Java, The Open University, Milton Keynes, UK*

Most of the research in the field of aging and implicit memory has focussed on perceptual tasks such as word stem and fragment completion, perceptual identification or anagram solution (see, e.g., Light & Dingh, 1987; Light, Singh, & Capps, 1986; Java & Gardiner, 1991; Java, 1992). A much smaller proportion of the literature concerns tasks of a conceptual nature. Moreover, while most of the work involving perceptual priming has tended to show little effect of age, the results of conceptual tasks have been less consistent. The present study employs word association as conceptual implicit and explicit tasks. Investigations were made into both quality and quantity of encoding and retrieval in the two types of task, and states of conscious awareness were examined in relation to age and task type.

#### 2.6.15 A proto-connectionist theory of memory

*G. V. Jones, University of Warwick, UK*

Quarter of a century before Hebb's "Organization of behavior", a member of Cambridge University published a chapter entitled "Memory" in which he proposed what may be viewed as the outline of a neural network theory of memory. However, this proto-connectionist theory attracted no subsequent attention. There appear to be two types of reason for this neglect. The first concerns the impossibility at that time of implementing the theory in the form of an explicit model. The second concerns the nature of its author's celebrated career. On the one hand, he did not himself subsequently develop further his theory of memory. On the other, the fact that he was not generally perceived as a psychologist probably impeded the dissemination of his theory among psychologists. The neglect of his theory demonstrates the range of factors other than the strictly scientific which can be important in determining the influence or otherwise of a psychological theory.

### 2.7 Language Processing

#### 2.7.1 Form priming with visible primes: Data and implications for theory

*L. Colombo, University of Padua, Italy, and S. J. Lupker, University of Western Ontario, Canada*

Form priming with clearly visible primes can provide useful information about the way in which potentially activated units are selected during word recognition. In the present paper several experiments are described, in which the effects of similarity in form between two words presented successively (form priming) are investigated. The words in the experiments were always unmasked and clearly visible. Several factors were investigated including the SOA, the type of task (naming, lexical decision, semantic classification), the spelling-sound regularity of prime and target and the letter position at which formally similar primes and targets mismatched. The general pattern of results is consistent with the proposal that inhibition effects are due to a fast-acting, automatic process whereas facilitation effects are due to a strategic use of the prime-target relationship. Implications of these conclusions for current models of word recognition are discussed.

### 2.7.2 The interaction between degradation and priming in lexical decision in English and Spanish subjects

*A. Burton and E. Burton, University of East London, UK, and J. J. Cañas and M. T. Bajo, Campus Universitario de Cartuja, Granada, Spain*

The performance of English and Spanish subjects was examined in two experiments using a lexical decision task in which the effects of semantic priming and stimulus degradation were systematically varied. The "Orthographic Depth" hypothesis predicts that priming and degradation will interact in the orthographically "deep" language (English) but not in the "shallow" (Spanish). In the first experiment, the two factors were found to interact in a similar way in both English and Spanish groups. In the second experiment, in which only Spanish subjects participated, the interaction was again present but only in those subjects who showed an overall facilitation effect on primed words. The results are consistent with the use of the so-called "direct" route in Spanish and are at variance with other previous findings which have suggested that reading in shallow orthographies occurs via the "indirect" phonological route. The results also suggest, however, that Spanish subjects may be more flexible in their reading strategy since fewer of them were found to show an overall semantic facilitation effect. There was also evidence that nonword rejection times were slower in Spanish subjects and that the performance of the two groups was affected differently by the different types of neutral baseline primes (asterisks or unrelated words). Studies of the effects of semantic priming on pronunciation are also currently in progress.

### 2.7.3 The representation of meaning relations in the bilingual lexicon: A closer look at the cognate-noncognate distinction

*R. M. Sánchez-Casas, St. Louis University, Madrid Campus, and J. M. Igoa, Universidad Autonoma de Madrid, Spain*

A substantial number of recent works on lexical representation in bilingualism have provided compelling evidence that cognate words from two languages have a distinct representational status when compared with noncognates, either because they have more similar meanings or share more conceptual nodes than noncognates (de Groot & Nass, 1991), or because

they even share a single lexical representation that is neutral to the two languages involved (Davis, Sánchez-Casas, & Garcia-Albea, 1993; Sánchez-Casas, Davis, & Garcia-Albea, 1992). The study we report was designed to investigate whether the degree of semantic overlap between Spanish-English cognate and noncognate translations has any effect on the bilingual subjects' performance in two related tasks: translation recognition and oral translation. A series of experiments using semantic priming at different SOAs were carried out with nonambiguous (the words have the same meaning in the two languages) and ambiguous translations (they have overlapping meaning across the two languages). So far our results indicate that meaning overlap has markedly different effects for cognates and noncognates.

### 2.7.4 Midwich cuckoos in the orthographic nest?

*Z. Kaminska and M. Dixon, City University, London, UK*

Recent research has indicated that encountering a misspelled word can disrupt subsequent spelling accuracy. It seems that a single incorrect exemplar - the "Midwich cuckoo" - implanted in the spelling lexicon has the power to disturb a previously correct orthographic representation. The nature of the effect, and particularly whether it can be averted or attenuated, was explored from a number of directions.

One approach measured explicit awareness of the incorrectness of the "cuckoo" exemplar, and related this to subsequent spelling performance. Others explored the effect more tangentially, varying for example the degree of automaticity of processing of the "cuckoo" through contextual manipulations, or probing the influence of a double implantation of the "cuckoo". Points of parallelism and divergence between the effect and the Midwich cuckoo phenomenon afford theoretical insight into its mode of operation and the nature of orthographic entries in the spelling lexicon.

### 2.7.5 Suffix frequency, productivity, and orthographic confusability as determinants of morphological processing

*Cristina Burani, Institute of Psychology of the National Research Council, Rome, and Anna M. Thornton, University of L'Aquila, Italy*

Some experimental evidence on processing and representation of Italian derived words is in favour of their decomposition into root and deriva-

tional suffix at some stage of visual lexical access (Burani & Caramazza, 1987). However, various properties of derivational affixes can be considered as relevant factors in affecting processing and representation of affixes as independent lexical units (Burani & Laudanna, 1992; Laudanna, Burani, & Cermele, submitted).

In the present research, lexical decision data on printed morphologically complex non-words were collected. The morphologically complex non-words included different types of derivational suffixes varying along some dimensions: number of both word-types and word-tokens including a certain suffix; suffix productivity, i.e. the property of a suffix to be used to form new words; the suffix's orthographic confusability, i.e. the ratio in the language between really suffixed and pseudo-suffixed words ending with the same orthographic sequence. The hypothesis was that the more frequent, the more productive and the less confusable a suffix is, the more recognizable as a processing sub-lexical unit it should be. The expected outcome therefore was that non-words including more recognizable sub-lexical units should show longer and less accurate decision responses. Results showed varying patterns of correlation of these factors with lexical decision performance, with orthographic confusability being the best predictor of differences in reaction times and accuracy. The data are interpreted within a model of lexical access in which lexical entries can be addressed through a morphemic access procedure, which is sensitive to properties of affixes.

### 2.7.6 Dutch compounds and morphological and semantic transparency

*P. Zwitserlood, Max-Planck-Institute for Psycholinguistics, Nijmegen, The Netherlands*

Semantically speaking, Dutch compounds can be transparent or opaque. The meaning of transparent compounds is compositional in that it be derived from their constituents ("stoofpeer", cooking pear). If such words are decomposed into their constituent morphemes during word recognition, their meaning can be constructed by combining the components at a lexical-semantic level of representation. But many Dutch compounds are semantically opaque, in which case the combined meaning of the component parts does not semantically specify the complex word, as with "mulpeer", literally a "muzzle pear", meaning "a slap in the face". Decomposition would lead to trouble with respect to the semantic interpretation of such words.

Two studies will be reported in which the processing and representation of compounds is studied as a function of semantic transparency. An

immediate repetition priming experiment in which the compounds ("stoofpeer", "mulpeer") served as primes and the constituents (STOOF, MUL, PEER) as targets revealed no differential amounts of priming as a function of semantic transparency. In a second study, both types of compound were used as primes for semantic associates of their constituents (e.g., MOND, mouth, for "mul", APPEL, apple, for "peer"). This experiment showed differences between transparent and opaque compounds. The results will be discussed in terms of their consequences for models of lexical access and representation.

### 2.7.7 Are morphemes really necessary?

*P. T. Smith, University of Reading, UK*

From an anglocentric point of view, the functional value of a morphemic level of description distinct from a word level of description seems slight: acquiring complex morphemic systems poses formidable problems for the learner, and, in the adult language user, a separate level of morphemic description seems just as likely to interfere with lexical access as to facilitate it.

These prejudices have been examined with connectionist models of word recognition (interactive-activation) and learning (back-propagation). By systematically varying the degree of morphemic involvement in the models and the regularity of the morphemic processes, it is possible to assess the value of a morphemic level to an efficient running of the systems.

The conclusion is that morphemes are really necessary, but only some of the time.

### 2.7.8 The role of strong syllables for spoken word recognition in Dutch

*J. Vroomen and B. de Gelder, University of Tilburg, The Netherlands*

The metrical segmentation strategy (Cutler & Norris, 1988) states that listeners in a stress language like English, segment the speech signal at the occurrence of every strong syllable. The present study investigates whether this approach can be applied to speech segmentation in Dutch. In a word spotting task, Dutch listeners made less errors in detecting words embedded in nonsense bisyllables when the second syllable was strong; "bel" was detected more accurately in "bel.koos" rather than "bel.kes". When the target comprised more than the initial syllable, there was no effect of metrical weight of the second syllable; "melk" was detected equally fast and



accurate in "mel.koos" as in "mel.kes". These results will be discussed in relation with similarities and differences between English and Dutch. It will be proposed that when the second syllable is strong, it is segmented from the first, and detection of the target is enhanced if it corresponds to the initial syllable ("bel" in "bel.koos"). If the target comprises more than the initial syllable ("melk" in "mel.koos"), successful recognition might even be hampered because speech material has to be assembled across the segmentation boundary. Models strictly based on phonemic or syllabic recoding cannot account for these results. It adds further evidence to the idea that strong syllables indicate a specific location of where to start lexical access.

### 2.7.9 Phonological priming between spoken words

*M. Radeau and J. Morais, Université Libre de Bruxelles, Belgium*

Phonological priming was examined as a function of the early or late position of the deviation between prime and target. The material consisted of pairs of monosyllabic words, three-phoneme long, which differed either by their first or their last phoneme but had the same other two phonemes in common. The role of prime-target relative frequency was also considered by using pairs of items including a word of high frequency and another of low frequency of which the order of presentation was reversed in separate conditions. Four experiments were run using a short (20 ms) or long (500 ms) ISI together with the lexical decision task or the shadowing task.

While words with initial overlap did not give rise to any priming effect, facilitation was consistently found between words with final overlap. The effect was obtained with both tasks and it was not affected by prime-target relative frequency. The size of the effect decreased as the ISI increased. These results are not consistent with models of spoken word recognition in which word onsets are emphasized.

### 2.7.10 Pre-readers implicitly encode regularities in print-sound mapping

*A. Content, Université Libre de Bruxelles, Belgium*

It is an accepted notion in research about reading acquisition that at the earliest stages, children learn a few written words through discrimination learning. A number of researchers have assumed that the use of this early knowledge must be severely limited, because it would be unproductive and accompanied by massive retroactive interference effects.

In two recent experiments in which non-readers and beginners were

taught small sets of items from artificial alphabets, we have examined transfer of learning and generalisation effects. In agreement with previous studies, no transfer effect was observed when explicit production was required in a forced-choice task. However, significant learning gains were observed with the transfer set, even though the regularities were based on character-phoneme correspondences, and the children were unable to analyse simple syllables as sequences of segments.

We conclude that learning gains constitute a more sensitive measure than overt generation, and that analytical regularities can affect performance without being explicitly extracted.

### 2.7.11 The importance of phonology in visual word recognition

*A. Verstaen, University of Leuven, Belgium, G. Humphreys, University of Birmingham, UK, and G. d'Ydewalle, University of Leuven, Belgium*

A central problem in the cognitive psychology of reading is the question of whether printed words are processed via a direct visual and/or an indirect phonological route. According to dual-route theories of lexical access, both routes contribute to the processing of written stimuli, the direct route being dominant. The inferiority of the phonological route has been challenged by Perfetti, Bell, and Delaney (1988). They found that backward masking with pseudohomophone masks induced better target recognition than backward masking with a graphemic mask that shared the same letters with the target as the pseudohomophone mask. From this, Perfetti et al. inferred the existence of automatic prelexical phonetic activation. We demonstrate in a series of experiments that this conclusion is too hasty. Automatic prelexical phonetic activation is observed only when the procedure encourages the use of a phonological reading strategy.

### 2.7.12 Strategic control in a naming task: Changing routes or changing deadlines?

*S. J. Lupker and P. Brown, The University of Western Ontario, Canada, and L. Colombo, University of Padova, Italy*

Monsell, Patterson, Graham, Hughes and Milroy (1992) have recently demonstrated that naming times for high-frequency irregular words and some nonwords are faster in pure blocks than when the two types of stimuli are

mixed together in the same block. These effects were attributed to a strategic de-emphasis of the assembly route in certain situations. Attempts to replicate these results were generally successful but also suggested that low-frequency irregular words (and some nonwords) are named faster in mixed blocks than in pure blocks, results which do not follow from the strategic de-emphasis explanation. A second experiment in which nonwords were mixed with regular words showed that both high- and low-frequency words were slowed by mixing but all nonwords were facilitated by mixing, another result that does not follow from the strategic de-emphasis explanation.

An alternative explanation for these results in terms of setting deadlines for when a naming response should be given was evaluated in two additional studies. In one study it was demonstrated that mixing high-frequency irregular words with low-frequency irregular words slowed the high-frequency words but sped-up the low-frequency words. In the final study, it was demonstrated that same case words were slowed by mixing them with mixed case words while mixed case words were facilitated. These results also can not be explained in terms of a strategic de-emphasis explanation. They are, however, quite consistent with the suggestion that when slow stimuli and fast stimuli are mixed together in the same block, subjects establish an intermediate time criterion for responding that reduces RTs for the slow stimuli and increases RTs for the fast stimuli.

### 2.7.13 Stroop effect in cross-script-homophones

*J. Tzelgov, R. Sneg, and O. Baruch, Ben Gurion University of the Negev, Beer Sheva, Israel*

Access to lexical representation is a major component of the reading process. Lexical entries of printed words may be accessed directly on the basis of visual features or via phonologic mediation. Single route theories argue that lexical access is always mediated by phonology. Single route explanations of skilled reading are consistent with process theories of automaticity that attribute automatic and nonautomatic processing to the same mechanisms. Dual route theories suggest that reading via the direct route characterizes skilled readers in particular for high frequency words. The dual route approach is consistent with the notion of automaticity as memory retrieval.

Autonomy is an aspect of automaticity indicated by an unintentional beginning of a process and its ballisticity. Stroop effect is a prime example for the autonomy of reading. Therefore if autonomous reading reflects memory retrieval, as suggested by the dual route approach, the Stroop effect should be absent when the visual cues that serve for retrieval under normal conditions are not available. This assumption was tested in series of

experiments in which Hebrew-English bilinguals had to name the ink color of stimuli presented in Hebrew and English with different script. In series of experiments the Stroop effect was obtained for cross-script-homophones stimuli that had meaning as color names in one language (e.g., Hebrew) but are written in a script of the other language (e.g., English). This effect was obtained independently of response language, level of experience with cross-script-homophones stimuli and response mode (manual or verbal). Additional experiments provided indications consistent with the assumption that different routes may be involved in lexical access in autonomous reading of regular stimuli and cross-script-homophones. Implications of these findings for automaticity and for theories of the reading process are discussed.

### 2.7.14 An integrated single-process model of visual word recognition

*G. Lukatela, University of Belgrade, Serbia/Yugoslavia*

Not too long ago, some scholars tried to sentence to death even the notion of prelexical phonology. Today, however, the question that serves as a useful focus for research may be reformulated as follows: "Does an adult reader of English ever use graphemic codes in addition to obligatory phonological codes?" In other words one can ask whether a demonstration of direct visual access can be given that is distinguishable from phonological mediation. This question will be under scrutiny in the present paper.

Given the kind of recently acquired knowledge (e.g., Perfetti et al., 1988; Van Orden et al., 1988; Perfetti & Bell, 1991; Lukatela & Turvey, 1991, 1993), it seems that the traditional dual-route principle must be turned on its head. Instead of the belief that lexical access is overwhelmingly achieved by visual codes, a revised model should recognize the historical fact that script has developed after speech, that the long-term memory developed to subserve speech, and that the intra-lexical codes should—for the sake of compatibility—be phonologically based. Consequently, relative to the prelexical graphemic codes the phonemic access codes are more "compatible" with the intralexical codes. In the framework of connectionist networks, the revised model assumes that—other factors being equal—the "phoneme-to-word" connections are stronger than those from "grapheme-to-word" and that, in the time course of a single interactive process (under normal reading conditions) there are greater chances for a phonologically rather than graphemically based lexical access. Drawing on Van Orden et al. (1990) who encouraged the abandonment of notions of separate, independent mechanisms of lexical access and developed an account in which multiple and varied subsymbolic processing units are all activated through a common matrix



of connection weights, whereby the phonologic coding plays the dominant role in the dynamics of lexical activation, I shall propose an integration of the Van Orden type subsymbolic network with the above outlined principle of the lexical vs. prelexical code compatibility. In addition, I shall assume that the interactive activation of (graphemic and phonemic) subsymbolic processing units is continuously integrated by each lexical processing unit.

The proposed integrated single-process model is supported by a series of new experiments.

### 2.7.15 Spatial format of a text and the strategies used by normal and fast readers

*V. I. Belopolsky, Institute of Psychology RAS, Moscow, Russia*

The spatial layout of a text imposes internal constraints on the efficiency of the reading process (see Tiker, 1965). The basic effects concern gaze control and/or perceptual span variation. Secondary effects of a text format touch on strategies of reading and comprehensive processing. The experiments were conducted to investigate the diversity of strategies in middle and top skilled adult readers. The varied parameters of the text were: (i) line width (20, 40, 60, 80 or 120 characters) and (ii) leading (2 or 3 points). 220 adult subjects were tested before and after a 2-month fast-reading training course. We used an inter-group design and assessed the progress in rate of reading, level of comprehension and eye movement patterns. The results revealed that the optimal formats were different for normal and fast readers. After training the readers had more flexible strategies than before it.

### 2.7.16 Speaker's meaning, sentence meaning, and the understanding of message adequacy

*L. Surian, MRC Cognitive Development Unit, London, UK*

Previous research in developmental cognitive psychology has suggested that between the age of five and six there is a major developmental shift in the conception of communication: children overcome a deficit concerning the concept of literal meaning. In this paper the relevant literature is reviewed and an alternative view is proposed according to which the understanding of communication does not undergo any significant change after the age of four and developments in message evaluation abilities are driven by the use of more accurate and more demanding strategies to infer the outcome of the listener's interpretation processes. These two views were compared by

(a) providing a more explicit account of the concept of literal meaning, (b) examining what sort of inferences we can draw from message evaluation data about the speaker's conception of communication, and (c) investigating children's sensitivity to the distinction between different types of literal ambiguity.

In Experiment 1, five-, seven-, and nine-year-old children were asked to evaluate clear, incongruous and ambiguous verbal clues. In each trial the child was told which one of the three cards was the intended referent and was asked to help the experimenter to choose effective messages to refer to that card. Children were given two different types of ambiguous messages. Quantity Maxim ambiguous messages were easy to interpret correctly by means of a pragmatic inference based on the Gricean first Maxim of Quantity whereas Misleading ambiguous messages suggested an interpretation that was different from the intended one. Results showed that the number of rejections of ambiguous messages increased with age. However, Quantity Maxim messages were judged to be adequate in all age groups. By contrast, most of the time Misleading messages were judged to be inadequate. In Experiment 2, seven- and nine-year-olds evaluated message adequacy in two conditions. In the same perspective condition, children were given ambiguous messages that from both the child's and the listener's perspectives did not suggest any safe interpretation, namely they were non-decidable. In the different perspective condition messages instead were non-decidable from the listener's perspective but they appeared to be Quantity Maxim messages from the child's perspective. Most seven-year-olds succeeded in the same perspective condition, but failed in the different perspective condition. Nine-year-olds succeeded in both.

Results suggest that the literal ambiguity of the messages does not play a significant role in the evaluation of communicative adequacy at any age. They indicate that the core component of message evaluation processes is the assessment of the listener's inferential opportunities. Both the domain-general explanation based on the Piagetian notion of egocentrism and the domain-specific explanation based on the deficit concerning the notion of literal meaning appear to be inadequate to explain children's egocentric biases. It is proposed that developments in message evaluation skills depend upon the use of heuristics that allow an accurate consideration of the listener's mental state and cognitive environment.

### 2.7.17 Contradictions between metaphors: A means of expressing an attitude

*D. Berntsen, University of Aarhus, Denmark, and J. M. Kennedy, University of Toronto, Canada*

The present paper challenges the inclination to interpret a corpus of metaphors in terms of an underlying, consistent idea – e.g., a “generic” metaphor (Lakoff & Turner, 1989) or an image schema (Johnson, 1987). It argues that insoluble contradictions between metaphors may be an important means of expressing an attitude.

A corpus of metaphors used in an autobiography of childhood is examined for contradictions. The childhood is described in terms of containment but the rule of transitivity is violated across the metaphors by the implicit statement: Childhood is in childhood. It is demonstrated that this contradiction serves to express an attitude of alienation, as it renders the childhood an omnipresent phenomenon leaving no room for the subject of the story. An ironical relationship between style and content is found, likewise serving an attitude of alienation.

The autobiographic metaphors are regarded as a reconstruction of the childhood experiences from the present viewpoint of the author. It is suggested that they reflect a condensation of a schema of autobiographic memories, similarly governed by an attitude of alienation.

### 2.7.18 Text-based probabilistic representation: Effects of the uncertainty and rhetoric arguments

*V. A. Tseptsov, Institute of Psychology RAS, Moscow, Russia, and P. Coirier, University of Poitiers, France*

The effects of the uncertainty and rhetoric arguments on the process of event reconstruction from the sequences of texts were investigated. An experimental model of natural argumentation processing includes primary hypothesis dynamic, judgments of provided argument relevance and utility. The experimental hypothesis proposed to explain the regularity of the probabilistic representation development as a function of the following characteristics of rhetoric arguments: length of the sequence (i.e., number of arguments used by the subjects to verify the initial information), functional relations between the arguments (additive, multiplicative), preferred arguments.

Experimental conditions: veracity of the initial information supported by strong or weak author's evaluation, sequence type: supporting, rejecting, mixed. In relation to the initial claim, each argument was constructed as to conform to the specific rhetoric structure: antithesis, epitrope, etymo-

logy, authority's argument. The results show that the primary effect of the uncertainty is a belief manifestation, which was initiated by the ambiguity of text (e.g., anonymous letter, reduced text). Two strategies of the representation updating were found: overconfident (1) - based on the primary hypothesis and underconfident (2) - based on the sequence of arguments. The length of the sequence is not linked with the strategy. Argument of authority is significantly preferred in the investigated sample.

Summaries written by the subjects in the concluding part of the experiment were analysed. The texts obtained reproduce important characteristics of the initially presented information, namely the rhetoric structures.

### 2.7.19 Rhetorical inferences, situation model, and reading instruction

*V. Billet and P. Coirier, University of Poitiers, France*

When reading a text, the reader constructs a situation model. This situation model integrates both the literal information from the text and the pertinent knowledge associated with it (Van Dijk & Kintsch, 1983). Such processing is often linked to inference drawing (Perrig & Kintsch, 1985). The present study examined the role of reading perspectives on the inferential processing. The material comprised five expository texts which had the following rhetorical structure (Meyer, 1975, 1977): the first paragraph described a problem; the second paragraph provided the solution; but understanding the solution required the two paragraphs to be related via an inference. For each of the texts subjects had to recognize three sentences: one valid paraphrase, one invalid paraphrase and either a valid inference or an invalid one. There were two different tests: one about content, one about literal form. Two different reading perspectives were proposed (the first one insisted upon the microstructural level; the second one stressed the rhetorical problem-solution structure).

*Results.* (1) Rhetorical inferences are always processed even if paraphrases are generally better recognized; when they are valid, inferences are quite as well recognized as valid paraphrases, but when they are invalid, inferences are less rejected than invalid paraphrases. (2) As a general rule, the answers concerning inferences are more uncertain than those concerning paraphrases. (3) Reading instructions play an important role in this uncertainty level with invalid inferences.

### 2.7.20 Writing argumentative essays: Textual and cognitive factors

*P. Coirier and E. Marchand, University of Poitiers, France.*

Minimal argumentative operations are observed very early in children (Clark & Delia, 1976; Pellegrini, Galda, & Rubin, 1984; Weiss & Sachs, 1991). However, the production of an extended and elaborated argumentative discourse or text happens to be a difficult task, even in adults. Different authors observed a marked evolution between 10 and 16 years of age (Brasard, 1988; Esperet et al., 1987; Coirier et al., 1990). Such an evolution may be explained by a lot of different factors: mastery of the complex linguistic tools required by argumentation (the concession connectives, for example), complexity of the reasoning process and of the textual planning when many interconnected arguments are to be used, taking into account the potential addressee, etc. In a preliminary study (Coirier & Marchand, 1992) we proposed different exercises to 11 to 17 year-old children. The obtained data showed that what is most difficult for pupils is the processing of the textual dimension: macrostructure, thematic composition, and cohesion when implying a high structural level.

The present experiment was designed to complete and systematize the above-mentioned results. The following exercises were proposed to 11 to 17 year-old pupils: (1) *macrostructure*: choosing among three statements the title corresponding to a short simple text; (2) *cohesion*: restoring pronouns, connectives and punctuation in a cloze text; (3) *thematization*: composing a short text to link four sentences, of which one is particularly difficult to relate to the others; (4) *counter-argumentation*: linking two sentences with opposing argumentative orientation; (5) *argumentative planning*: composing an argumentative text from nine statements among which complex argumentative dependencies were pre-established (quasi-logical dependency, incompatibility, ...). Besides, the results of these exercises were matched with the data observed in two free argumentative essays, concerning the formal and structural aspects: presence of typical argumentative markers, structural complexity of the supporting procedure, instantiation of a minimal superstructural schema. Once again it was observed that the main developmental trend concerns the global thematic composition, and particularly when it is linked to the argumentative planning.

### 2.7.21 A text analytical approach to the developmental study of writing processes

*E. van der Pool and C. van Wijk, Tilburg University, The Netherlands*

Three basic acts have to be performed before actually writing a text: activating, selecting and organizing information. These mental processes leave their traces in the written texts. A structural text analysis can reveal these traces and thus provide a solid, empirical basis for the development and testing of a psycholinguistic theory of the writing process.

Any such theory must distinguish between shallow and deep processing, where shallow processing is associated with a minimally connected mental representation of the text. Shallow processing is assumed to make minimal use of world knowledge and thus lends itself for formulation in explicit rules that can be applied without dependence on any analyst's intuitions.

Based on linguistic and psychological discourse theories, a text analysis algorithm has been developed and implemented which yields a minimally connected hierarchical text representation. This procedure, called PITA (Procedures for Incremental Text Analysis), incorporates findings of linguistic research with respect to the location of subordinate clauses, the type and syntactic position of referential expressions, semantic features of the main verb, the use of connectives, and so forth. The method has been successfully applied to descriptive and explanatory texts written by experienced or inexperienced writers. It is robust with respect to performance characteristics such as incomplete and disorderly presentation of information.

The procedure was applied to a corpus of 50 descriptive texts produced by 10-, 12-, and 15-year-old students. Their task was to describe the person they wanted to be like. They had chosen either a person they knew (relative, neighbour, teacher, etc.) or a public figure (politician, sportsman, artist, etc.). We will show in this paper how the derived representations provide information about developmental changes in the underlying cognitive processes, such as content generation, organization, goal setting, and tuning to the reader.

### 2.7.22 Slips of the tongue, self-repairs and silent pauses in Spanish: A comparative study of schizophrenic and normal speakers

*M. Belinchon and P.-Ch. Shih, Universidad Autonoma de Madrid, and S. del Viso, Universidad de Oviedo, Spain*

The classic interpretation of the so-called schizophrenic language as a disorder of central and conceptual processing which does not affect grammatical processing (Bleuler, 1911; Carroll, 1986) has recently been re-examined as a consequence of results derived from psycholinguistic studies. Rochester et al. (1977) and Shih (1991), for example, showed that the duration and pattern of spontaneous pauses in schizophrenic speech were significantly different with regard to those of their controls; these differences were particularly clear in relation to the codification of syntactically low-dependent clauses. On the other hand, a linguistic analysis of syntactic errors made by the same patients of Shih's study, carried out by Fernandez-Lagunilla et al. (1992), also revealed a significantly higher frequency of errors affecting the organization of sentences' deep structure in schizophrenics than in the control group (psychiatrically normal).

In the present study, we try to go deeply into the nature of the grammatical encoding peculiarities of the same schizophrenic patients of both previous studies, comparing the slips of the tongue and self-repairs they produced with those produced by a control group of psychiatrically normal subjects in three different tasks (narrative, description and explanation). Furthermore we analyze the results of this comparison together with those derived from the analysis of frequency, position and duration of spontaneous silent pauses, in order to check whether some convergent evidence could be obtained on behalf of the hypothesis of a grammatical deficit in schizophrenia independent of deficits in conceptualizing. The findings obtained are discussed in the light of proposals by Levelt (1983) and van Wijk and Kempen (1987) about self-repairs, by Chaika (1990), Frith and Frith (1990) and others about schizophrenic language.

### 2.7.23 Syntactic planning in speech and attentional resources: An experimental study through spontaneous pauses

*P.-Ch. Shih and M. Belinchon, Universidad Autonoma de Madrid, Spain*

The existence of severe attentional deficits in some pathological conditions (e.g. adult psychoses) has been systematically posed as the best explanation of the difficulties these people have in producing fluent, coherent and grammatically well-formed discourses. Moreover, some empirical work analysing the pattern and duration of spontaneous pauses in speech confirmed that schizophrenics suffering such attentional deficits performed some processes of grammatical encoding in a different and less efficient way – specifically, processes at the so-called functional level (Rochester et al., 1977; Shih, 1991).

In spite of their importance from a psycholinguistic point of view, empirical studies focusing on functional relationships between attention (viewed as global amount of processing resources) and verbal production are scarce, except for studies analysing the specific processing load during speech production (Ford and Holmes, 1978; Power, 1986). Therefore, we do not yet have a very detailed description of what are the grammatical encoding processes involving the highest processing demands, and we cannot predict the exact consequences of some attentional problems on language production.

The present study tried to get some insights about this problem in an experimental fashion. We asked two experimental groups (normals, in psychiatric terms) to recount the plot of a short movie and simultaneously perform a non-automatable task (the Continuous Performance Test, CPT). We compared their patterns of pauses with those obtained from a control group performing the verbal task without distraction. Results are discussed from both a methodological and a theoretical point of view.

### 2.7.24 Internal speech functioning in visual and visual-tactile supported speechreading

*B. Lyxell and J. Rönnberg, Linköping University, Sweden*

In four experiments the role of internal speech in visual and tactually supported speechreading in deafend adults and normal hearing individuals was investigated. Internal speech functioning was assessed by a broad range of tests of lexical access, memory span and rhyme-judgement. The results re-

veal no differences between the groups for speed of processing in lexical access and rhyme-judgement tasks, whereas a significantly lower accuracy level was obtained for the deafend adults. This difference was particularly prominent in those cases where the test items were either homophonous or orthographically similar to real words. These two types of test items were also correlated to the number of years that the subjects had been deaf. Additional experimentation did not lend support to the alternative hypothesis that the results reflect a shift of information-processing strategy (e.g., from a phonologically based to a visual). For the deafend group a significant correlation was obtained for level of accuracy and speechreading performance (visual as well as tactually supported). Furthermore, an error analysis revealed a significant interaction such that the deafend adults made significantly more phonologically based errors in speechreading tests than the normal hearing group, whereas there were no differences between the groups when other verbal categories were considered. The results were discussed with respect to (a) how and what aspect of the internal speech that is affected by deafness acquired post-lingually, and (b) the role of internal speech in speechreading.

## 2.8 Reasoning and Decision Making

### 2.8.1 30-year secular trends in the cognitive abilities of Danish male school-leavers at a high educational level

*T. W. Teasdale, University of Copenhagen, Denmark,  
and D. R. Owen, City University of New York, USA*

A nationally representative sample of Danish males finishing school in 1989, or shortly before, with a *studentereksamen* (the highest qualification in the Danish school system) was found to score generally lower on a battery of four cognitive tests than a comparable sample of Danish males who had taken the same tests shortly after finishing school in the late 1950's or early 1960's. This decline appears attributable to the increasing proportions of students who obtain the *studentereksamen* and is quite compatible with an overall increase in test scores, also found in our data, for the general population over the same time period. For those who obtain the *studentereksamen*, the decline has been most marked in a test of verbal analogies. It has been smaller for tests of logical and spatial reasoning, and scores on a test of numerical ability have actually improved over the 30 years. This differential pattern may be the result of both student changes and curricular changes within Danish schools.

### 2.8.2 Temporal reasoning

*W. Schaeken, University of Leuven, Belgium, P. N. J. Johnson-Laird, Princeton University, USA, and G. d'Ydewalle, University of Leuven, Belgium*

We conducted three experiments to investigate how people reason about temporal relations. The mental model theory of reasoning predicts that problems which depend on constructing one model should be easier than problems which depend on constructing multiple models. A theory of reasoning based on rules of inference, however, predicts that problems which require fewer inference steps should be easier than those which require more steps. In the first experiment the number of steps was held constant, but the number of models was varied. In the second experiment the problems consistent with one model required more inference steps than the problems consistent with two models. The results of both experiments supported the model-based theory. In the third experiment we measured also the latencies, and again the predictions of the model-based theory were confirmed: Problems consistent with one model required less time and were easier than problems consistent with more models.

### 2.8.3 Pragmatic inferences

*E. van der Meer, Humboldt University Berlin, Germany*

Pragmatic inferences play a crucial role in everyday communication and reasoning, but so far they have unfortunately been analyzed to a very limited extent, and besides they are controversially discussed in the literature.

The aim of our experiments was to examine the cognitive background of types of semantic relations between event-related concepts which belong to pragmatic or higher-order inferences: finality, causality and temporal order. The nature of these semantic relations was investigated both in priming experiments (lexical decision tasks: word vs. pseudoword) and in relation identification tasks.

The results indicate that the analyzed semantic relations are characterized by a common component: the "arrow of time". This arrow is reflected in a directionality of recognizing meaningful relationships between event concepts related by finality, causality or by temporal order corresponding to the natural course of events in our environment. It is also reflected in special priming effects.

The results also indicate that the cognitive nature of these relations is different. Typical finality relations seem to be activated automatically. Causality and temporal order between event concepts seem to be mainly

based on controlled processes, which lead to context-dependent recognition procedures.

The underlying mechanisms of pragmatic or higher-order inferences will be discussed and conclusions concerning human reasoning in text processing will be made.

#### 2.8.4 Autobiographical memory: Its role in novel problem solving

*B. H. Dritschel, University of East London, and D. A. Bekerian, MRC Applied Psychology Unit, Cambridge, UK*

The present study explores the role that autobiographical memory, in particular memory for specific past experiences, plays in problem-solving. Current theories of human problem solving suggest that the problem-solving process is influenced by knowledge about, and experiences of, analogous problems. The experimental hypothesis is that individuals employ specific past experiences as analogues in order to generate solutions to novel problems, but that the problem-solving strategy is influenced by the degree of novelty of the problem. The more difficult a problem, the less likely it might be that subjects would be able to draw on specific past experiences and analogues, and the more likely it would be that they would resort to other strategies such as ends means heuristic processing.

In this study, subjects were presented with 6 questions each containing 3 items constituting problems that might be encountered in everyday life with varying degrees of novelty. Results suggest that the degree of novelty of the problems, and hence the probability of their occurrence in everyday life, influences the strategy employed to generate a solution in the direction predicted by the experimental hypothesis.

#### 2.8.5 Considering the knowledge you have: Realism in confidence judgments

*C. M. Allwood and P. A. Granhag, University of Göteborg, Sweden*

Previous studies successful in affecting the level of subjects' confidence judgments have often utilized their spontaneous knowledge activation (e.g., Griffin & Tversky, 1992). The purpose of our study is to analyse the effect on the realism of subjects' confidence judgments by making them heed content which might be expected to lower their confidence ratings. This

was implemented by making subjects actively consider the limits of their knowledge in a domain.

The study involved 40 subjects, half in the control condition and half in the experimental condition. All subjects answered 60 general knowledge questions by choosing one of two answer alternatives. Next, they rated their confidence in the chosen answer on a scale ranging from 50% (guessing) to 100% (absolutely sure).

Before each question the subjects in the experimental condition rated their knowledge in a knowledge domain which included the question which followed. This was done on a scale ranging from 1 (very little knowledge in the area) to 5 (very great knowledge in the area). Each subject rated two types of knowledge domains: broad (for example, history) and narrow (for example, Swedish history), where the broad definition always included the narrow.

We assumed that the domain knowledge rating would lead the subjects to consider the limitations of their knowledge in the domain in question and that this consideration would lead the subjects to give more moderate confidence ratings. In line with this, our hypothesis was that the confidence judgments in the experimental condition would show a higher degree of realism compared to those made in the control condition.

However, our data analysis showed no significant differences between the control and the experimental conditions with respect to our dependent variables: calibration, over/under-confidence, resolution, proportion correct and confidence.

The results suggest that the scale on which the subjects rated their domain knowledge was not efficient as a means to realize the goal of the manipulation. In an ongoing experiment the subjects are asked to estimate how large a percent of the total knowledge currently existing in a domain they master on a scale from 0% to 100%. We expect this scale to be more efficient in making the subjects consider the limitations of their knowledge.

From a normative point the subjects' ratings of their knowledge should be lower in broad compared to narrow knowledge domains. This is due to the fact that the broad domains encompassed more knowledge than the narrow domains since the broad domains always included the narrow domains. However, our analysis showed that the subjects were insensitive to this dimension in the experiment. The mean ratings for broad domains and narrow domains were 2.60 and 2.29, respectively ( $df = 19, p < .001$ ). A possible explanation for this finding is that the subjects diagnosed their knowledge level through an activation process where the outcome results from an "availability effect". If the subjects used this strategy, it seems reasonable that they would have been able to activate as much of their knowledge (and/or lack of it) in, for example, Swedish history as in history.



### 2.8.6 Decision making under self-reflection conditions

*V. L. A. Tatko, Independent Union for Brain and Behaviour Research, Moscow, Russia*

The auto-reflection of decision making was studied with 40 volunteers by evaluation of reaction time (RT), latent period of subject's doubts arising, accuracy in task performance, and level of doubts. The study was based on a screen metaphor, which presupposes the existence and necessity for consciousness of at least two structures whose images of external inputs are accessible to each other (Abdusamatov et al., 1987; Tatko, 1989). According to the metaphor, the reflection is an endless process of image exchanges between screens, where the next image is the result of the previous one on the opposite screen. Examples of structures of this type in the brain are retinal dotted images as well as dotted projections areas in thalamus and cortex.

The study focussed on two phenomena: (1) individual peculiarities in the time course of a discrimination process and the on-going reflection of its results and (2) the influence of context on the result of reading.

Pairs of letters like P and R, and O and Q, were displayed on an IBM SVGA monitor in one of the 4 quadrants symmetrical to the axis being crossed in the point of gaze fixation. The computer program for generation of pseudo-randomized sequences of letters made it possible to change the percentage of identical pairs that were delivered one after another in chain, as well as the number and length of the chains, both for similar and different pairs.

The subjects used a key-board for quick answer if the pair presented contained the same letters or not. In addition they were asked to evaluate the level of own answer correctness immediately after it to decrease the penalty for error. No biofeedback was introduced. Ten subjects were asked about a priori assessment of success level in the next pair recognition.

The  $d'$  and  $d''$  statistics (Tatko, 1991) revealed the independence of self-estimation function from the external information processing. Time course analysis of decision making showed the existence of 3 possible combinations of RT and doubts latency (DL): 816 and 420 ms, 1000 and 250 ms, and 1250 and 420 ms, in each series average terms. For the second combination it is possible to say about special mode of subject answer, when the decision about doubts preceded the letter recognition answer. The correlation between a priori and posterior estimates of decision success proved the conclusion in the group with this mode.

The analysis of subjects' tactics and strategy at the micro level, which permits to escape the averaging (Tatko, 1992), showed a prevalence of combinations of a long RT with a long DL ( $P = .55$ ), compared with long-short

( $P = .2$ ), short-long ( $P = .1$ ) and short-short ( $P = .2$ ) ones. For each subject the tactic's type and its replication ability looks like an individual performance characteristic. The only factor influencing the constancy of marked tactics was the variability/homogeneity index of the input information. In cases of 3-7 repeated presentations of the same letter pair in chain, only a few persons were able to suppress their reaction on increasing of input information uncertainty degree (Tatko, 1989).

In the group of 40 subjects it was possible to see the full continuum of reflection magnitude. At one pole were the subjects who were unable to stop the reflection process by themselves. From a clinical point of view, it was interesting to find the highest percentage of obsessive-compulsive disorders (in the past), tendency to stammer, and echolalia in this group. At the other pole of the continuum were persons showing bad letter recognition and absence of doubts. The combination of bad recognition and absence of doubts represents another group of clinical interest, but it was relatively seldom.

The main results of the study are in a good agreement with both electrophysiological (Johnson & Donchin, 1985) and psychophysical (Poppel, 1988; Tatko, 1989) data and may be generalized through the embedded information cycles model (Tatko, 1988, 1989, 1990).

### 2.8.7 Calibration analysis for expert-novice probabilistic reasoning with medical content

*J. G. Labra, I. A. Pinedo, and A. J. G. Trillo, Universidad Nacional de Educación a Distancia, Madrid, Spain*

Research on experts and novices has shown that both groups exhibit an overconfidence effect on their judgments under uncertainty and biased responses on probabilistic reasoning. The aim of this work is to identify expert-novice sensitivity to sample size, base rate and diagnosticity data when reasoning and assessing their confidence with problems within their field of expertise. Results indicate that calibration on diagnosticity problems discriminated between the performance of expert midwives and student nurses. Regardless of the overconfidence effect obtained, experts presented the best calibration on those problems that involve diagnosticity data. Nevertheless, experts are in general more confident than novices and do not discriminate between statistical and biased answers when assessing their confidence on these responses.

### 2.8.8 Offender profiling: Can AI tools help in the prediction of burglars?

*A. Akyürek, J. Jackson, and J. A. Michon, NISCALE, Leiden, The Netherlands*

Offender profiling is a technique which is designed to help the police in the detection of offenders. Its main aim is to use characteristics from the scene of the crime (e.g. type of instrument used to break in), the modus operandi, the type of goods stolen, characteristics of the victim, and reports by victims and witnesses, and to use these to predict the characteristics of the possible offender. While it is not expected that such techniques will always, or indeed often, be able to pinpoint the individual culprit with a high level of accuracy, such techniques should be able to reduce the range of potential suspects. In other words, the aim of such a technique is to narrow down the range of people who could possibly be the offender by specifying a combination of characteristics that the offender is likely to possess.

This paper describes the development of an offender profiling system, based on AI techniques, which has been devised to predict house burglars in an area in the west of The Netherlands. The necessary data, which includes clues from the scene of the crime and objects taken as well as characteristics of the offender such as age, life-style, drug addict or not, etc., are collected in three ways: from analysis of criminal files; transcripts of observations made by the police at the scene of the crime; and structured interviews with detectives. Protos, a machine learning program which acquires knowledge for performing expert heuristic classification, is then used to build a computer-based "profiler" which should be able to assist the police in their investigations.

### 2.8.9 Some lessons on the representation and use of knowledge, from studies of compensatory responses to system malfunctions

*D. Gopher, Technion, Haifa, Israel*

How do performers respond to malfunctions and technical problems that occur during their interaction with an engineering system? On many occasions, rather than halting the system, calling maintenance, or sending the system to be repaired, operators decide to continue their work and compensate for the problem by adopting alternative modes of response. We label such responses "compensatory behaviors", because the performer takes upon himself the responsibility to compensate for the malfunction, or replace the system in a task segment previously performed by it. Compensatory behaviors are common in all areas of interaction between humans and technology. For example, when the car wipers do not clean the windshield properly, the driver may still decide that he is sufficiently capable of seeing through. When the car brakes are somewhat loose, the driver may decide to reduce speed, allow for larger braking distances, pump the brakes gently, etc. These are compensatory behaviors. It is surprising that despite its prevalence in daily interactions, compensatory behavior has not been the subject of scientific research.

Adoption and selection of compensatory behavior can be argued to anchor in three basic "Mental Models": the system, the self and their interaction. Stated differently, the knowledge bases and mental representation that an operator has of the physical system, his model of his own capabilities, and his perception of the interaction between these capabilities and the requirements of the task. From this perspective, the study of compensatory behavior is related to the existing body of research investigating the nature of operators' mental models of systems and the influence of such models on performance (e.g., Gentner & Stevens, 1983; Moray, 1987; Sanderson, 1989). However, previous research has dealt exclusively with models of the physical system and addressed only tasks of detection, diagnosis and response decision in the event of failure (e.g., Morris & Rouse, 1985; Rasmussen & Rouse, 1981). The study of continuing compensatory behavior thus broadens both the scope of modelling and the range of tasks described.

Under what circumstances, how often and at what cost, would operators be likely to adopt compensatory behavior? How justified and efficient is this behavior, as compared with the costs of halting and repairing the system? How would such behavior be influenced by the performer level of knowledge and experience? These are several of the questions that have been addressed in a series of studies conducted in our laboratory. Subjects interacted with a simulated, semi-automatic, computerized work-station of a chemical plant, requiring the control of 5-8 filling stations for hazardous liquids. Different malfunctions were introduced intermittently at a single station or the total system level. Subjects could respond by selecting one of several compensatory behaviors, differing in their information processing and response requirements (manual, perceptual, computational). Alternatively, they could decide to stop and have the system fixed by maintenance. Failure in compensatory behavior resulted in an explosion, which was heavily penalized. Maintenance help had its own price.

We shall discuss the main results of an experiment which varied the type and level of knowledge that performers had been given on the system and the task. One group went through an elaborated discussion of the chemical system, its components, transfer functions and on-going processes, as well as the characteristics of different compensatory behaviors. A second group



received only basic operation instructions and accumulated knowledge through hands-on experience. Subjects had 2, two-hour sessions on a system without malfunctions, followed by 2 additional sessions during which malfunctions were introduced. The data showed that despite the high cost of error and explosions, both groups preferred compensatory behaviors over fixing the system in the majority of the cases. Subjects in the group that was given deeper and broader knowledge were more likely to adopt compensatory behavior, and were more explorative in testing alternative behaviors. At the same time, when compared to the relative costs of repairing the system, these subjects were less successful in applying compensatory behavior early in training. Their overall production scores were lower than those of the group that received only limited procedural knowledge. Only with extensive experience, subjects with broad knowledge showed advantage for compensatory behavior over the costs of fixing the system, and obtained better scores than subjects with limited knowledge.

It is proposed that the added knowledge has not only improved subjects' mental models, but also increased their self confidence and willingness to take risks. The latter were harmful in early stages, because when required to cope with malfunctions subjects failed to evaluate the costs of their lack of experience in carrying out compensatory behaviors. Only with experience, the benefits of knowledge could be realized. This type of judgment error and its costs may be more general and characterize human performance when moving from theory to practice, or from a well trained to a less experienced task. Aside from its theoretical significance, the findings have important implications to work safety, design of work procedures and development of training schedules.

#### 2.8.10 Cognitive aspects of learning and cooperation in simulated ship manoeuvring

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T. Clemmensen, Danish Maritime Institute, Lyngby,  
Denmark*

The paper presents a task analysis of modern ship manoeuvring and compares it to the learning outcome of a simulator course conducted by 22 highly experienced navigators. Gathering of maritime knowledge and formulation of navigational rules were the most central learning effects found, while the development of manoeuvring skills depends on signals not yet fully presented in the simulator. Analysis of various measurements of manoeuvring performances shows a strong *learning by observing* effect among colleagues, and identifies reversing along the wharf as a simple, yet most central in-

indicator of the navigator's control competence. On this basis, new research projects, simulator improvements and ways to augment the training effect are suggested.

#### 2.8.11 Compatibility and restructuring explanations of the prominence effect in choice

*T. Gärling, University of Göteborg, H. Montgomery,  
University of Stockholm, and M. Selart, University of  
Göteborg, Sweden*

Research in decision making has demonstrated a prominence effect in that a prominent or predominant attribute receives higher weight in choice than in judgment. The paper reviews this research with the aim of determining whether the compatibility hypothesis proposed by Tversky, Sattath, and Slovic (1988) is a tenable explanation. According to this hypothesis, the prominence effect arises because of a higher-order compatibility between input information (decision alternatives) and output (choice or judgment). However, the prominence effect may equally well or better be explained by an alternative hypothesis based on Montgomery's (1983) theory of dominance structuring in decision making. This hypothesis states that in choice, although not in judgment, the decision maker uses several mental restructuring operations on a representation of decision options to make the options more clearly differentiated. Several of the authors' experiments are also reported. The results are in general agreement with the alternative restructuring explanation.

#### 2.8.12 Intentionality, beliefs, and reasoning

*H. Wermus, Université de Genève, Switzerland*

Inferential activity and argumentation are among the most important thinking processes of the mind. Following Piaget "Thinking is transformation of meanings"; mental meanings are generated from sets of cognitive representations, i.e. from (cognitive) semantic nets. The different properties of these semantic nets like egocentrism, prototypical images, amalgamations of several kinds, systemic rigidity, distortions of reality etc. have an impact on the inferential processes. The transformations of representations: Focusing, differentiation, forgetting, activations of various kinds, transfers of meanings, analogies, abstractions etc. form the core of the thinking processes.

It is well known that all these thinking processes are strongly related to the intentional subsystem of the mind (which I call the  $\psi_2$ -subsystem; the  $\psi_1$ -subsystem is the cognition). Intentional functors like beliefs and other

modalities, pragmatics, different kinds of attitudes, emotions etc. manage all these processes. One has to be aware of the fact that there does not exist a modally (or in general intentionally) neutral proposition in mind, despite the circumstance these functors are mostly tacit or not expressed. Intentional functors may diminish or increase the force of an argument; the inferential moves like reasoning, decision of a match or a mismatch in a correspondence, choice of relevant parameters and hypotheses in a task, even truth valuations depend on the functors of the  $\psi_2$ -system.

Most importantly  $\psi_2$ -functors like beliefs, introduce nontrivial changes into rules of classical logic. In fact cognition makes use of several specific logics (named *protologics*) distinct in many respects from the classical formal one. These protologics form a lattice with growing "discernability relation"; this fact induces peculiar properties of inference rules using connectives of the protologics. The discernability relation determines the degree of the so-called "accessibility relationship" which is important in dialogue, in teaching etc.

I intend to comment the foregoing views on hand of several examples performed in labors of experimental psychology in Geneva. These examples exhibit some relevant properties of human representations and also of reasoning habits which are deviant from valid rules of formal logic. These deviations may rise the problem of adaptation of usual mind processes to a complex reality. Further an intensive  $\psi_2$ -functor may induce conflicts between subjects or prevent a convergence of a dialogue.

The influence of intentional functors on thinking, revealed for example in the efficiency of persuasive argumentation, rise important epistemological problems. Let me just mention the question of the come about of truth valuation and of meaning formation (or understanding processes); it may appear that knowledge and intelligent behaviour does not depend as much from rational (or scientific) truth valuations: truth by coherence or by correspondence with an experience ("adequatio rei et intellectus"), but of an estimation of a match or a mismatch of a representation of a correspondence in mind, i.e., intelligence is related to a *psychological truth*.

## 2.9 Emotion and Personality

### 2.9.1 Integral bias in the cognitive processing of emotionally linked words

*M. Martin, University of Oxford, and G. V. Jones, University of Warwick, UK*

Human cognitive processes are subject to systematic biases associated with particular emotional states. Two different hypotheses concerning the development of such biases are compared. The Integral Bias hypothesis asserts that the effects of emotion on cognition reflect integral links between emotional states and cognitive mechanisms, links that are not arbitrary but instead are fixed constituents of our mental architecture. In contrast, the Inferred Bias hypothesis asserts that these effects arise as a consequence of the gradual establishment of associations between particular emotional states and particular patterns of cognitive behaviour. In order to compare these two hypotheses, the cognitive effects of a phobia were studied using different types of Stroop task. It was found that the magnitude of the observed bias remained approximately constant irrespective either of the ages of the participants or of the durations of their phobias. The magnitude of the bias was also found to remain approximately constant irrespective of whether acquisition could be attributed to direct, modelled, or informed experiences (or other causes). These findings provide strong support for the Integral Bias explanation of the cognitive effects of an emotional disturbance.

### 2.9.2 Effects of negative mood on the capacity of short-term memory

*K. Spies and F. W. Hesse, Universität Göttingen, Germany*

To explain the observed decrease of performance due to negative mood it is assumed that part of the limited capacity of the cognitive system is needed for mood-related processing (Ellis & Ashbrook, 1988). Thus, in a negative compared to a neutral mood less capacity can be submitted to the task at hand. Within the memory model by Baddeley (1986, 1990) capacity is related to several subsystems of short-term memory as there are: central executive, visuo-spatial sketchpad and phonological loop consisting of phonological store and articulatory control process.

In the present context mood dependent capacity reductions are investigated for central executive and phonological loop. Capacity of the pho-

nological loop usually is assessed via memory span and speech rate. Thus, capacity of this subsystem rises with the number of items that can be held in memory and with the speed of information processing. Daneman and Carpenter (1980) propose another measure, the reading span, that can be assumed to measure the capacity of working memory as a whole. Thus, there is a possibility to derive an indirect measure for the capacity of the central executive (together with the visuo-spatial sketchpad) from the difference between reading span and memory span. While for memory span monosyllabic words must be held in memory, for reading span subjects must remember the last word of sentences consisting of about twelve words.

In the investigation negative and neutral mood states were induced experimentally using a combination of the Velten method and music presentation. There were  $N = 30$  subjects in each group. Results showed on the one hand that memory span was lower for subjects in a negative compared to a neutral mood. Additionally, there was a tendency for a lower speech rate in the negative group. On the other hand, there was no difference between the two groups with respect to the difference between reading span and memory span. Thus, the decrease of performance in a negative mood cannot be attributed to a reduced capacity of the central executive but must be due to reductions of the capacity of the phonological loop.

Mood effects may be due to impairments of the articulatory control process that refreshes information via rehearsal. In this case, the mood dependent decrease of memory span should disappear if the articulatory control process is suppressed. This can be done by letting subjects continuously repeat "one, two, three, one, two, three ...". Results showed that suppressing the articulatory control process even enlarged the mood effect. Thus, according to the framework of the memory model, mood effects on memory span must be due to a reduced capacity of the phonological store. Mood effects should then be more distinct for dissimilar compared to similar words as this similarity effect is attributed to characteristics of the phonological store. Results showed a corresponding tendency.

Taking all results together the observed mood dependent decrease of the memory span cannot be ascribed to a reduced capacity of the central executive. It may, however, be due to a reduced capacity of the phonological store. As the effects become even larger if the articulatory control process is suppressed, it seems that people in a negative mood use this control process more carefully and thus are able to partially compensate for the reduction of the phonological store.

### 2.9.3 Contingency model of creative processes

*T. Maruszewski, Adam Mickiewicz University, Poznan, Poland*

The model assumes that creativity is a function of the format of the information constituting the problem representation and personal dispositions. The dispositional factors include cognitive preferences linked with the use of specific way of coding - visual or verbal coding. This way of coding may be at least in part determined by constitutional factors such as functional asymmetry of brain hemispheres. None of these groups of factors, while acting in isolation, is sufficient condition of creativity. It is hypothesized that when the specific format in which a problem is presented fits the cognitive preferences of a subject, creative solutions might appear. 80 subjects solved four groups of tasks (2 tasks in each group). These tasks were similar to Guilford's divergent thinking problems. Half of the subjects were given tasks in visual form, the other half in verbal form. Both groups of subjects were further divided: Half of each group was given instructions suggesting a "global" way of solving, half - a "step by step" way of solving. Cognitive preferences were measured with Nosal's Scale of Mind Type (referring to Jung's typology). Hemispheric dominance and the level of intelligence were also determined. The results confirmed the model only partially. Significant differences were found in tasks measuring semantic fluency. However, there are some indirect indices supporting the model. It was also found that in case of each Jungian type different determinants of problem solving efficiency appeared.

### 2.9.4 Ways of telling: Autobiographical disclosure of influential psychologists

*G. Altomare, University of Copenhagen, Denmark*

How someone distills the essence of how s/he has developed personally and professionally and organizes it into a meaningful and compelling narrative is of considerable interest to a broad public. Autobiographical accounts of the career choices of eminent psychologists tend to reveal both the discovery of a wide range of interests and the need to focus upon specific fields of inquiry demanding complete concentration and dedication. Using the autobiographies of such luminaries as Bruner, Freud, Gregory, William James, Jung, Melanie Klein, Herbert Simon, Skinner, as well as others, an attempt will be made to construct a taxonomic framework encompassing the totality of a psychologist's interests in different spheres of knowledge. Use both of Sternberg's triarchic theory of knowledge and Gardner's eightfold scheme

for types of intelligence will be employed. Among the questions to which preliminary answers will be sought will be: (1) How might psychologists differ from those who pursue other careers such as novelists or architects?, (2) What factors combine to impel a person to choose a particular branch of psychology?, and (3) What salient indicators may be identifiable in distinguishing those who achieve high visibility in their profession? The results, albeit tentative, should be of interest to a large number of people. Furthermore, the talk should provoke heated debate and stimulating verbal exchanges between all participants.

## 2.10 Disorders and Rehabilitation

### 2.10.1 On cognitive functioning and health

*L.-G. Nilsson, University of Umeå, Sweden*

Various aspects of cognitive functioning will be discussed in relation to different components constituting the concept of health. The basis for the discussion is an ongoing prospective study on memory, aging and dementia involving about 3000 subjects randomly sampled from the population of Umeå, a city of 95000 inhabitants in the north eastern part of Sweden. Cross sectional data from a first wave of data collection will be presented. These data are based on 1000 subjects in 10 different cohorts, 35, 40, 45, . . . , 80 years of age when first tested. In addition to general issues on cognition and health some specific questions related to dementia will be discussed. Among other things these include possible preclinical, cognitive signs and risk factors of Alzheimer's disease.

### 2.10.2 Naming faces and recognising names: A case study of an aphasic subject

*T. Brennen, University of Oslo, Norway, D. David and J. Pellat, Hôpital Michallon, La Tronche, Grenoble, France*

The behavioural symptom common to all aphasic patients is a deficit for naming tasks. In this paper we report the case study of an amnesic aphasic patient (OBB) who had a particular problem for naming people, while remaining able to recognise them and to classify them semantically. Furthermore, when naming faces she presented the peculiar symptom of failing to recognise the correct name, *even when it was her who uttered it*. Our study attempted to explain this observation within the framework of face and name processing by normal subjects (Bruce & Young, 1986; Burton,

Bruce, & Johnston, 1990). In order to explain OBB's failures to confirm a name as the right one, it was hypothesised that she may be unable to determine whether a name belonged to a famous person or not. However, she performed with few errors on a name familiarity decision task. Subsequent testing showed that OBB's access to semantic information concerning famous people was worse when the *name* of the person was presented compared to when it was the *face* of the person that was presented. This result accounts for her "feelings of strangeness" and is compatible with a model like Bruce and Young's (1986) where access to the semantic system is dependent on the modality of input, but incompatible with a model such as Burton et al.'s (1990) where familiarity decisions and semantic decisions are amodal. Using an artificial face-name-profession learning exercise, we demonstrated that OBB's differential access to semantic information was found even for items for which the amount of learning was controlled and so her performance is not due to differential exposure to names and faces in everyday life.

### 2.10.3 Imagery as a mnemonic aid in amnesia patients: Effects of amnesia subtype and severity

*A. Gade, University of Copenhagen, Denmark*

Thirty-five amnesic patients, in four subgroups, were studied in the paired associate task introduced by Jones (1974). Three lists of concrete noun pairs were presented and tested in three learning trials and retention one hour later. The first list was presented under standard conditions, i.e. without requests of any specific strategy. The second list was presented with imagery instructions and illustrative pictures. For the third list the patients were requested to generate their own images.

Improvement under imagery conditions was seen in all subgroups. However, severely amnesic patients benefitted minimally from imagery. Patients with moderate deficits improved considerably from illustrative pictures, but less so with self-generated imagery. Mildly amnesic patients improved greatly, and the improvement was maintained with self-generated images.

These results indicate that severity of amnesia may be decisive in determining whether imagery instructions aid amnesics, and this could explain why previous studies have produced conflicting results. Versions of a dual code hypothesis attributing a dominant role to the right hemisphere in the visual imagery effect are not supported by the results.

#### 2.10.4 Reality monitoring in a hypothetically hallucination-prone population

*J. M. Ruiz-Vargas, I. Cuevas, and J. M. Lopez-Frutos,  
Universidad Autonoma de Madrid, Spain*

Following the reality monitoring model (Durso & Johnson, 1980; Foley, Durso, Wilder, & Friedman, 1991; Johnson & Raye, 1981), we investigated the performance of hypothetically hallucination-prone subjects and normal subjects in a source discrimination task. It may be postulated that the same control processes which allow us to explain normal and disturbed functioning in reality monitoring in normal subjects, are used by the hypothetically hallucination-prone population. In fact, Bentall et al. (1991) suggested that hallucination could be explained in terms of failures in reality monitoring. We report two experiments that were carried out with an external source discrimination task. The first experiment included three independent variables: hallucination-proneness (high and low), material (words and pictures), and task (naming, function, and explicitly imagery). In the second experiment, we manipulated the same variables plus the delay variable (zero, one day, and ten days later). The results indicated that there are no differences in discrimination of external source between both groups. Only when imagery was generated implicitly (function condition) the failures in reality monitoring increased. Seemingly, these results can not be explained in terms of low recognition. Moreover, delay per se affected equally both groups. These results were discussed in terms of variables underlying control processes that allow to postulate the conditions in which the probability of failures (normal and pathological) in discrimination task increases.

#### 2.10.5 Competing models in computerized cognitive rehabilitation after brain injury

*P. M. Pedersen, Bispebjerg Hospital, Copenhagen,  
Denmark*

I. Robertson (1990) presented a pessimistic review of the outcome of computerized cognitive rehabilitation: most studies either had negative outcome or was insufficiently controlled. Since then a number of well-controlled studies have had more encouraging results. In particular, it has been shown that computerized procedures offer a degree of control over the type of the training given and the progress of the patient that is difficult to obtain when therapists are administering traditional training methods (Katz & Wertz, 1992). Moreover some well-controlled successes and – not the least

– some of the failures that led to Robertson's pessimism have fostered a re-thinking of the models for cognitive rehabilitation.

In the short history of cognitive rehabilitation two models have been dominating: the functional reorganization model of Luria (1963) and the fading cues model of Weinberg et al. (1979). A basic assumption in both models seems to be that cognitive functions impaired after brain injury cannot be exercised in a direct and simple way like a muscle. However some of the best studies of computerized and traditional methods have shown surprising results. Robertson, Gray, and others have shown computer programs with fading cues to be entirely without effect in neglect rehabilitation (Robertson et al., 1990). At the other hand rather direct computer retraining of divided attention had promising results (Gray et al., 1992). With traditional methods Howard's group has shown a semantic method (simple pointing to pictures) to be more effective than a phonemic cuing method (Howard et al., 1985a, 1985b).

At present the best candidate for a general model for cognitive rehabilitation is thus the conceptually most simple model: Direct retraining of functions, but with careful planning aiming to isolate the function (or sub-function) in need of training, to reduce distractions from irrelevant stimuli, and to eliminate interference from unnecessary demands on output functions.

#### 2.10.6 State of cognitive and praxis functions in patients after brain injury

*D. Rapaic, University of Belgrade, Yugoslavia*

Brain injury is dramatic in its dynamics and manifestations. Certain phases, such as acute and postacute, are unpredictable in its development, so it is necessary to provide prompt and adequate intervention. The consequences of the adolescent brain injuries are extremely dangerous. They interrupt the course of development of the young people.

*Method and results.* There were two groups of examinees. One group consisted of car accident victims with brain injuries and the other group consisted of normal examinees. Members of both groups were more or less of the same age, education level and sex. Testing has been carried out with both groups by Protocol for apraxia and Composite test for cognitive functions. Testing results show the achievements of both groups in comparison with the maximal possible score in subtests. Besides, there has been cross analysis of the attained results of experimental and control groups.

### 2.10.7 Theories of consciousness with specific reference to methods in research

*R. Willanger, University of Copenhagen, Denmark*

Several of the neuropsychological syndromes comprise disturbances in consciousness. Roughly speaking all neuropsychological syndromes do, but some are more centrally placed as documentation of disturbed consciousness than others:

Visual neglect, anosognosia for hemianopia or hemiparesis, blindsight and agnosia will in this connection do as illustrations of the centrally placed syndromes with salient features illustrating disturbances in consciousness. The amnesic syndrome in Korsakoff's psychoses is another. Broadly speaking, most of the different syndromes associated with brain lesions have an illustrative value of the spectrum of features in consciousness disturbed. Analyses of the dimensions concerned when one is talking of disturbances in consciousness is the main topic for this presentation.

The purpose of this paper could be stated in four points: (1) To present in brief the salient tendency in cognitive neuropsychology to describe processes and levels of functions pertaining to understanding processes and lesions in the human brain. (2) To underline the risk in information process theories to neglect or suppress descriptions of possible disturbances in content in consciousness. (3) To point to the rich harvest of the information process analyses in describing processes and levels in the human organism. (4) To link this description to a great interest in unraveling the problems of awareness in the knowing, conscious person. A better understanding here could immediately be of great value in rehabilitation of patients with the above-mentioned syndromes.

The paper describes three experimental traditions in psychological research with phenomenological implications and aims of describing content and quality in consciousness. In the final statements hints are made to the old existential philosophy and psychology tradition linked to the Danish Kirkegaard description and the phenomenological psychology tradition.

## Chapter 3

## Symposia

### 3.1 Symposium on Visual Selective Attention

*Convener: H. Shibuya, University of Copenhagen, Denmark*

Visual selective attention is one of the central topics in cognitive psychology. There have been many papers on this topic at previous general conferences of the European Society for Cognitive Psychology, but the papers have been scattered among different sessions. The present symposium on visual selective attention should provide an opportunity for summarizing the state of the art in this field in Europe and promoting integrated discussions among researchers in the Society. It seems particularly appropriate to hold the symposium at the Sixth Conference of the Society, at which Professor Charles W. Eriksen, University of Illinois, delivers the Opening Address in his brothers' home town, Elsinore.

#### 3.1.1 Attentional scanning in the selection of central targets from multi-letter strings?

*B. Hommel, Max-Planck Institute for Psychological Research, München, Germany*

Noise letters flanking a central target letter may facilitate or interfere with target classification, depending on whether they are assigned to the same response as the target or to an alternative response. This flanker effect may

indicate that letter codes are activated in parallel, thus leading to response competition. However, it is open to question how this conflict is settled.

One means could be that activated letter codes are serially scanned and checked for the location of the sensory codes of their features (i.e., "late" selection by "early" criteria). If so, the scanning operations may follow certain rules (e.g., from left to right as in reading). Consequently, it was investigated whether the size of the flanker effect depends on the specific position of the flanker. Five-letter strings served as stimuli, consisting of a central target, a single (compatible or incompatible) flanker, and three neutral letters.

In fact, the flanker effect was more pronounced when the critical flanker was to the left than to the right of the target. In further experiments, it was investigated how this asymmetrical flanker effect varies with certain features of the stimulus material (letters vs. mirror-letters, letters vs. icons, conjunctively vs. disjunctively defined targets, etc.). The results do not strongly support the assumption of a single fixed scanning rule. They, however, fit to the idea that (a) letter codes are serially scanned according to selection values assigned to them, and that (b) selection values are assigned depending on both the temporary task context and long-term requirements.

### 3.1.2 Attention and lexical decomposition in reading Chinese: Linguistic knowledge guides spatially selective attention

*Y.-P. Chen and A. Allport, University of Oxford, UK*

Chinese orthography provides a number of interesting contrasts with alphabetical writing systems. The majority (over 90%) of Chinese single-character words are compound, consisting of a lexical radical (LR) and one or more other constituents which together form the "non-radical component" (NR). The NR component, as a whole, specifies the syllabic pronunciation of the whole word (except in the case of "irregular" words). In contrast, the LR specifies (an aspect of) its meaning.

Thus, in pronunciation tasks, the skilled reader should attend selectively to the NR component. To do so, however, she must first find the LR, which can occur in practically any relative location (e.g. top, bottom, left or right of the character), in order to segment, and so attend to, the NR component. Moreover, the same physical constituent can function as the LR in some characters, but as (part of) the NR component in others, depending on its relative location. Thus neither a strategy of attending to a fixed spatial location in a character, nor to a fixed set of physical consti-

tuents, is sufficient. Accordingly, selective attention to the NR component must be guided by high-level orthographic/linguistic knowledge.

We describe a series of experiments, demonstrating the effects of lexical decomposition in word-recognition by skilled Chinese readers, showing a strong attentional bias towards the NR component in pronunciation tasks, and an attentional shift to the LR in semantic judgment tasks. These results provide striking evidence of the interactive, knowledge-based control of selective visual attention.

### 3.1.3 Stimulus-driven capture and attentional set: Selective search for color and visual abrupt onsets

*J. Theeuwes, TNO Institute for Perception, Soesterberg, The Netherlands*

Recent evidence suggests that the occurrence of attentional capture is contingent on the attentional control setting induced by the task demands (Folk, Remington, & Johnston, 1992). Because the experiments on which these conclusions are based can be criticized for several reasons, the contingent capture hypothesis was tested by means of two visual search tasks in which subjects searched multielement displays in which a color singleton and an onset singleton were simultaneously present. When subjects had to search for a color singleton, on some trials another location contained an irrelevant onset. In addition, when subjects had to search for an onset singleton, on some trials another location contained an irrelevant color singleton. Both experiments show that the contingent capture hypothesis does not hold: irrespective of attentional set, attention was captured by the most salient singleton. The results of these experiments, together with previous findings, suggest a stimulus-driven model of performance in which selection is basically determined by the properties of the featural singletons present in the visual field.

### 3.1.4 Voluntary attention switching between global and local levels

*D. Vorberg, Technical University of Braunschweig, Germany*

Our visual attentional system enables us to concentrate on an object's global shape as well as on its details. What happens when we switch attention between such levels of an object description? I will describe a series of reaction-time experiments with a paradigm that makes it possible to estimate the time necessary for a switch. Voluntary switching times are on the



order of 150–300 ms, and depend on the direction (global-to-local vs. local-to-global) and the diameter difference of the attentional spotlight. The long times seem partly due to disengagement prior to switching. This is evidenced by much reduced switching times when the start stimulus disappears and when start and goal stimuli are separated by a delay.

### 3.1.5 Time course of elementary processes underlying visual selective attention

*H. Shibuya, University of Copenhagen, Denmark*

There has been a long debate about whether attentional selection is a serial or a parallel process (e.g., Atkinson et al., 1969). It has been argued that it is impossible to decide the issue on the basis of data from psychological experiments because of the so-called *identifiability problem* (Townsend, 1970, 1971): for a serial model it is possible to construct a mathematically equivalent parallel model, and vice versa. I review the serial–parallel debate and describe the nature of the mathematical equivalence between parallel and serial models. I argue that “plausibility” is an important criterion in selecting the best model (see also Vorberg & Ulrich, 1987).

Reanalysis of the data by Shibuya and Bundesen (1988) appears to show that a parallel model with a fixed total processing capacity is the most plausible model (Shibuya, 1991). Such a model was shown by Bundesen (1990) to give coherent quantitative accounts of the major findings reported in the literature on visual selective attention.

The data of Shibuya and Bundesen (1988; see also Loftus et al., 1992) also suggest that the time course of the elementary processes underlying visual selective attention is well approximated by exponential distributions, which are the simplest probability distributions for waiting times. I report new data from an experiment that was designed to determine the detailed shape of the distributions, and I discuss the implications of the results.

### 3.1.6 Visual selective attention and personality

*E. Necka and B. Szymura, Jagiellonian University, Krakow, Poland*

Two experimental studies are reported in which measures of performance in the visual selective attention task were correlated with chosen personality variables. Apart from taking into account the classic personality dimensions provided by Eysenck’s EPQ, the authors employed a new assessment instrument, called Intellectual Experience Scale, which is supposed to measure certain individual traits belonging to the “grey area” between

intelligence and personality. These shared aspects of personality and intellect include such traits as: Pragmatic-Utilitarian Attitude, Intellectual Absorption, Intellectual Pleasure, and Intellectual Aversion. In order to assess attentional parameters, a specially devised computerized test of visual attention was employed. The relationships that were found between attentional parameters, on one hand, and personality variables, on the other hand, allowed to sketch a theoretical model, which outlined the hypothetical cognitive mechanisms of individual differences, including intelligence, personality, and intelligence-related personality variables. In this way, the attentional mechanisms are considered to constitute the elementary information-processing bases of individual traits.

### 3.1.7 Aging and mechanisms of visual selective attention: A comparison of object and word localization and identification

*T. L. McCalley, IPO Institute for Perception Research, Eindhoven, The Netherlands*

Recent age comparison studies by McCalley and Bouwhuis (1992a, 1992b) have indicated that, when acuity is controlled, a single resource allocation model of attention best explains the behavior of both young and old adults. However, within the model, differences in strategies between the two groups can be identified which most likely reflect visual and cognitive interactions. Earlier results were based on a paradigm requiring the localization and identification of a geometric figure among similar nontargets. The present study extends the theoretical model to word localization and identification in an effort to determine whether the strategic differences in attentional allocation between the age groups, apparent in the earlier studies, would carry over to written text. Changes in acuity with age are also addressed as an underlying concept for this, and similar, studies. Results are discussed in terms of their general theoretical importance and their relationship to both theoretical and applied topics in aging.

### 3.1.8 Space-based visual attention models and object selection: Constraints, problems, and possible solutions

*W. X. Schneider, Ludwig-Maximilians Universität, München, Germany*

One of the functions of visual attention is the selection of external object information. This seems to be in line with an influential group of attentio-



nal models which assume that attentional selection is space-based. These models assume that selecting an object in vision is realised by selecting the location of that object. Whether this relatively simple idea of space-based attention and the corresponding, more elaborated space-based models are sufficient to handle selected constraints and problems of object selection is the main issue of this talk. The first step to an answer is to describe the common computational structure of space-based attentional models. Two model classes will be distinguished: capacity-limited models (e.g., Treisman, 1988; LaBerge & Brown, 1989) vs. models which do not assume a capacity limitation (e.g., van der Heijden, 1992). Next, three kinds of tasks and data on object selection are introduced that are especially challenging for space-based models. The first type of data refers to experiments which require selection between overlapping objects. The second type of data concerns the influence of "early" perceptual grouping – a strong object-defining factor – on "late" response competition, and the third type consists of a selection task in which a high-level (semantic) attribute defines an object and controls selection. In all three cases, problems of space-based models are analysed and possible solutions are sketched. Finally, a brief evaluative summary is given.

### 3.1.9 Towards a resolution theory of visual attention

*Y. Tsal, Tel Aviv University, Israel*

The paper proposes that preattended visual information produces a coarse representation by automatically stimulating a detector that responds to a range of similar features. Directing attention to a given location improves the resolution of features by computing the relative activation of overlapping internal detectors. A selective review of the literature shows that the proposed distinction is supported by a variety of studies investigating diverse phenomena of target-background similarity effects, background homogeneity effects, conjunctive search, illusory conjunctions, global precedence, shape discrimination, detection of signals, and categorical search.

### 3.1.10 Modularity and attention

*A. H. C. van der Heijden, University of Leiden, The Netherlands*

There is abundant evidence that the visual information processing systems of higher animals are modular systems; systems consisting of relatively isolated networks of neurons that take the visual world apart (see, e.g., Felleman & Van Essen, 1991, for an overview). Within cognitive psychology

this modularity is seen as a problem that requires a solution. The problem is "How then does the brain put together all these different activities to produce a unified picture so that, for example, for any object the right colour is associated with the right shape?" The solution is "... focal attention provides the 'glue' which integrates the initially separable features in unitary objects" (Crick, 1984; Treisman & Gelade, 1980). In this presentation I defend an opposite point of view. In this view, focal attention is regarded as a (theoretical or conceptual) problem that can be solved in terms of modularity (not modularity as a problem solved by attention but attention as a problem solved by modularity). Modularity is taken to be at the basis of the answers nature has offered to solve two major selection problems in vision; the selection of an action and the selection of the object to act upon.

## 3.2 Symposium on General Architectures of Cognition

*Convener: J. Krems, University of Regensburg, Germany*

Architectures of cognition provide a set of mechanisms that allows a system to acquire and to use content (information about the environment and the system itself) for achieving goals (A. Newell). They define a fixed structure, changing comparatively slowly if at all, that realizes a symbol processing system. Differences in behavior arise mainly from changes in goals and knowledge and not from properties of the architecture. Pylyshyn (1991) added two further ways to look at architectures: as counterparts to algorithms and as theories of cognitive capacity.

The main focus of this symposium will be to discuss the impact of cognitive architectures for theories of information processing. This will be done on two levels: (1) On a conceptual level: Do architectures provide a formal language that is useful for expressing process models of human behavior? (2) On a methodological level: Using an architecture allows to build models in which the task knowledge is strictly separated from the mechanisms of the architecture implementing that knowledge. Furthermore, a full architecture relates a model to data from other, seemingly unrelated experiments. Does this increase the constraints which have to be met by a model proved empirically "plausible"?

### 3.2.1 Architectures of cognition as unified theories

*A. Akyürek and J. A. Michon, NISCALE, Leiden, The Netherlands*

An objective of cognitive science is to determine the architecture that sub-tends and supports (human) cognition/intelligence. An architecture is a fixed, though slowly evolving, structure that brings about behavior through specific processes and interactions among these, which it can support. In this paper we discuss cognitive architectures and address general questions such as their general status, the behavioral, biological, and social constraints under which they have to operate, as well as methodological implications for empirical research.

### 3.2.2 On the impact of cognitive architectures on single domain theories

*R. Cooper and T. Shallice, University College London, UK*

Whilst cognitive architectures yield constraints that apply across a variety of domains, the constraints that one architecture imposes on any particular domain are weak. Single domain phenomena tend to be described within the architecture by the direct translation of some single domain theory (SDT) into that architecture. The utility of working within an architecture is therefore unclear. We argue that (1) if one works within an architecture, then it is vital to distinguish architectural constraints from the "implementation" in that architecture of an SDT; (2) the utility of architectures may lie in comparing translations into a particular architecture of competing SDTs; and (3) SDTs which do not fit neatly into an architecture will be of critical interest in any attempt to falsify the architecture.

### 3.2.3 General cognitive architectures and computational models of learning

*J. Nerb and J. Krems, University of Regensburg, Germany*

A remarkable benefit of cognitive architectures is to offer inherent criteria for evaluating the plausibility of a computational model. For example, the built-in chunking mechanism in Soar can be used in order to assess the validity of a model: the model's progress of learning can immediately be compared to empirical data from subjects. Moreover the automatically built

chunks can be analyzed on a semantic level according to domain criteria and according to results from research on skill acquisition.

By means of a scheduling task we will show how using a simulation model of skill acquisition can help to examine the microstructure of subjects' performance. The model, based on the Soar architecture, fits many qualitative (e.g., learning rate) and quantitative (e.g., solution time) effects found in the data from previous studies. The episodic memory chunks it learns show how rule acquisition can be performed without resort to deliberate rule construction. It also provides an explanation of the noise typically found when fitting a set of data to a power law of learning – it is the result of chunking over knowledge rather than "average" knowledge.

### 3.2.4 The role of cognitive architectures and cognitive models in knowledge acquisition and knowledge engineering

*T. Rothenfluh, School of Medicine, Stanford, California, USA*

Cognitive architectures are frameworks which provide an overall, integrative psychological theory of human cognition. While paying full respect to empirical findings and theories of the cognitive sciences concerning perception, memory, learning and other information processing characteristics of human reasoning, some have also been advanced to the stage of testable and executable computational models. In contrast, knowledge engineering tries to develop and (re-)use efficient computational representations and algorithms while maintaining a human-friendly interface to support decision making and complex reasoning. To facilitate knowledge acquisition, knowledge maintenance and knowledge re-use, more and more consideration is given to the psychological aspects of the various phenomena involved in the development and use of knowledge systems.

In order to tackle some acute knowledge engineering problems—which essentially require appropriate ways of dealing with the features and limitations of (human) cognitive processing systems, both on the sides of "experts" and "knowledge engineers"—it seems promising to integrate ideas and computational frameworks from psychological modeling into the knowledge engineering methodology. In order to overcome the ad-hoc nature of most of the "psychological" integration attempts, the activities of knowledge engineers as well as the use of cognitive frameworks to prototype knowledge systems have to be studied and contrasted to the more traditional knowledge engineering approaches.

### 3.2.5 On-line learning, automatic abduction, and multi-component systems

*A. Müller, Universität Göttingen, Germany, and A. Marostica, Los Angeles, USA*

Considerable attention in cognitive sciences has been paid to the solution of the "world model reorganization problem", i.e., the adaptation of a given knowledge structure to new or contradicting facts (cf. McDermott & Doyle, 1980). In this paper we first address some recent developments both in neural network theory and in symbolic logic. Second, since these approaches emphasize the co-ordination of specialized components (e.g., inductive and deductive subsystems), there will be a more general discussion of multi-agent models. The paper closes with an evaluation of the psychological (empirical) relevance of these models.

## Chapter 4

## Posters

### 4.0.1 The influence of alcohol abuse upon change of intellectual level

*E. M. Aranowska and J. B. Slawinska, University of Warsaw, Poland*

A representative sample of prisoners amounting to 1244 persons from all the Polish penitentiaries was tested with a classic scheme of psychometric investigation. All persons tested were divided into the following groups: alcohol dependent, systematically alcohol using, and periodically alcohol using. Their intellectual efficiency was tested using the intelligence test of Wechsler-Bellevue. Methodological principles for comparison of intellectual levels between groups that differ with respect to social and demographic factors are discussed. Conclusions relating to the changes of intellectual level are formulated and the character of the changes referring to the structure of prisoners' personalities identified with MMPI are discussed.

### 4.0.2 Does implicit memory show a serial position effect?

*B. Brooks, Goldsmiths' College, London, U.K.*

During the past few years a number of dissociations have been shown between explicit and implicit memory (see Roediger & McDermott, in press, for a review). In this study a further possible dissociation is examined – whether stem completion involving implicit memory fails to show the serial position effect found in free recall (e.g., Glanzer & Cunitz, 1966)? When explicit cued recall and implicit stem completion were compared, only the

explicit test showed a significant primacy effect.

#### 4.0.3 An exploration of negation in natural language

*A. Catelain and J. Caron, Université de Poitiers, France*

Psycholinguistic studies of negation have mainly focused on the syntactic processing of negative sentences, largely ignoring the semantic aspects of the problem: in most cases, linguistic negation is conceived as a logical operation. In fact—as developmental studies have already shown—linguistic negation appears as a complex set of operations, which can vary in nature and in scope. The present study aims at exploring the different kinds of cognitive operations that correspond to linguistic markers of negation.

A set of 10 French negative markers was chosen, each of which was used in two sentences (one with a verb of state, the other with a verb of process). Three groups of 50 French speaking subjects were presented with those 20 sentences, and were given one of the following instructions: (1) reformulate each sentence, without using a negative marker, (2) produce a sentence with the opposite meaning, (3) complete each sentence with “but ...” A typology of the subjects’ productions was made on formal criteria, and the data from each of the three tasks were submitted to a multidimensional analysis.

Results lead to distinguish a variety of negative operations, which can be characterised in the frame of Culioli’s theory of utterance operations (“opérations énonciatives”). These operations occur at different levels of processing of the utterance (“prédicative” vs. “énonciative”). Moreover, they may work either inside the proposition (on subject, predicate, or both) or outside of it (bearing on the whole sentence). Further research has to characterise the kind of contextual factors which determine these differences.

#### 4.0.4 The role of goals in reasoning

*S. Chaiklin, University of Aarhus, Denmark*

This paper reports the results of a theoretical project that seeks to understand the role of goals in the acquisition of a theoretical understanding of a physical system. The work was motivated by a speculation reported in Simon, Newell, and Klahr (1991) that goals (i.e., attention to particular relations) are critical for children’s acquisition of number conservation. Unfortunately, Simon et al. (1991) do not concretely specify different kinds of performance in relation to different goals. The theoretical goal of the present project is to present a series of models that show the relation between

goals and reasoning about a physical system. The analysis is carried out for the balance beam, a physical system studied by Piaget and subsequently investigated by many researchers from both empirical and theoretical perspectives. The analysis is presented as a series of computer simulation models, based on Soar 6.0. The purpose of the paper is clarify the role of goals in reasoning about the balance beam and show their consequences for how children answer questions about the balance beam. This project is part of a larger project that is trying to further specify the concept of “zone of proximal development.” Given the importance of goals in problem solving, it is possible to consider that these goals can be formulated through joint interaction with another person. The series of models, reflecting different goals, can be conceptualized as the consequences of working within different zones of proximal development.

#### 4.0.5 Emergency cognition at the ship’s bridge

*T. Clemmensen, Danish Maritime Institute, Lyngby, Denmark*

Most analyses of accidents at sea consider human errors in terms of insufficient actions in need of control. There have been some noticeable accidents at sea in the past few years indicating that this control need to be done at many levels, e.g., by legislation, quality management, selection of men and technological safeguards. This paper presents a hierarchical task analysis of emergency management on board passenger ships, and applies the identified tasks in a categorial analysis of 10 maritime accident reports. While there are substantially more equipment-related tasks identified in the reports than expected from the hierarchical task analysis, few self-related activities take place. Closer analysis of the distribution of cognitive tasks during the accidents shows the crew’s strategies to depend on the informational characteristics of the specific situation. Fire on board favours a strategy of attending to organizational knowledge, while equipment knowledge is most used during collision. In conclusion I propose that the control approach to safety be supplemented with categorization of the information available to the crew during fire and collision accidents at sea. I suggest also that knowledge of the informational characteristics of accidents at sea may be central for training and equipment design.

#### 4.0.6 Reasoning and models in electricity

*J. Crépault, Université Paris 8, France, and O. Megalakaki, Université de Crete, Greece*

The aim of this research was to study the effects on judgments about brightness of bulbs and branch currents of different types of problem structure and circuit diagrams (bulbs and/or cells in series and parallel circuits). Three groups of subjects were interviewed individually: students in technology program in community college, electrical technicians and electrical engineering technicians. The information provided dealt with two types of problems: (1) qualitative information: identical cells and bulbs; (2) spatial configuration of the circuit. Four types of problems were presented: (1) bulbs in series; (2) bulbs in parallel; (3) cells in series; (4) battery in parallel. In the first step, the subjects were asked to make a judgment on the brightness of bulbs for 8 problems. In the second they were asked to make a judgment about branch currents and brightness of bulbs.

The results showed that the judgments (correct responses) about brightness of bulbs and branch were very poor in students in technology and electrical technicians. A significant difference was observed between these two groups and electrical engineering technicians. The current division rule and conservation of current was accurate at all groups. The "battery wear model" (battery determines the flow of the current independently from number of bulbs) and "sequential reasoning" were very salient in the first two groups.

Our results suggested that the notion of current led to considerable confusion in students in technology and electrical technicians. A theoretical model (stable/unstable cognitive systems) is proposed for the analysis of the patterns and the relations between current, voltage and resistance networks. It can be hypothesised that subjects act within a system based on several functional rules.

#### 4.0.7 Learning as the base of human movement coordination

*N. V. Doonskaya, Russian Academy of Science, Moscow, Russia*

The approach to motor learning based on modern theories of motor control and robotics is described. Usually it is supposed that the process of human movement control includes a transformation from external coordinates (describing the position of a goal in the environment) to internal coordinates (describing the position of the body) which is carried out by brain structure.

res. However, the processes underlying this transformation have not been understood.

The present approach does not imply any transformation between two coordinate spaces or any other complex calculations. Instead of this it is supposed that not all internal coordinates involved in the movement are actively controlled, but only a few of them that are found during a learning process. In this work human movements are referred to as the result of long mastering of the body as a control object by brain control structures. During the learning process pulses of neuronal activity are chaotically generated and the reaction of limbs on them is remembered. As a result, a few movement parameters (basic parameters) are found that satisfy the following three conditions. First, the basic parameters define grossly movement of the whole body or some part of it (arm, leg). Second, their values can be controlled by very simple control signals (of bang-bang type). Third, the parameters are dynamically independent of each other, that is, variation of one does not influence the others.

The number of the basic parameters is much less than the number of degrees of freedom of a human body. All redundant degrees of freedom are either not actively controlled, but moved by reaction forces, or are actively controlled, but this control is auxiliary, depends strongly on the control of the basic parameters and is used to correct the movement in accordance with the movement goal. The described conception is supported by the leading link hypothesis on coordination of human movements (Doonskaya, 1992), which is based on the results of nonlinear control theory of multijoint mechanical objects. This hypothesis provides, in principle, the possibility of coordinating multijoint movements in the described way.

The process of human movement learning can be compared with acquisition of skill in horse riding. A rider does not calculate trajectories of all the horse's limbs and does not control each of them. Nevertheless, he can successfully enforce a horse to move in the desired direction with the desired speed, controlling only the position of its head in the main. By analogy, regulation of human movements is the result of a process by which we learn "to drive" our body in simple manner comparing with the complexity of a human body structure.

#### 4.0.8 Working memory tests and text comprehension strategies

*M. R. Elosúa, I.E.P.S., and J. A. García-Madruga, M. Gárate, J. L. Luque, and F. Gutiérrez, Universidad Nacional de Educación, Madrid, Spain*

This research is focused on the relation between the working memory capacity as a pool of cognitive resources and text comprehension. Recently, Just and Carpenter (1992) proposed a theory claiming that both processing and storage are mediated by activation, and the total amount of activation available in working memory varies among individuals. From this theoretical background an experimental study (pretest-intervention-posttest) has been designed with the aim of investigating the relation between three variables: (a) the working memory capacity, (b) different school levels (7th and 11th grades), and (c) the efficient use of three major strategies in comprehension and memory for text (main ideas identification, backtracking, and outlines construction). Thus, a Spanish version of "Reading Span Test" (Daneman & Carpenter, 1980), a modified version of "Working Memory Digit Task" (Oakhill, Yuill, & Parkin, 1986), and finally, a test to assess the performance in comprehension strategies have been developed. These measurements will be discussed related to the performance of reading comprehension strategies. Later, an intervention program based on active use of comprehension strategies will be carried out, taking into account the results from the above-mentioned tests.

#### 4.0.9 Incidental vs. intentional learning in the processing of everyday objects

*E. García-Bajos and M. Migueles, Basque Country University, San Sebastian, Spain*

In this study the memory effects of intentional and incidental processing of two common objects – a hundred pesetas coin and a Spanish identity card – are analyzed through a reproduction task. In Experiment 1, the subjects using intentional learning were more accurate and made fewer errors and omissions for the coin than did a control group that had not received previous practice, the performance of that last group being very low. In Experiment 2, the subjects using intentional learning showed better reproduction, both of the coin and the identity card, than did the group with incidental learning and the control group, there not being any difference between these last groups. Finally, a limited number of characteristics of both objects were recalled with great precision under all conditions, but

other details were not. These results indicate that of familiar objects only their more representative characteristics are recalled, whereas other irrelevant and secondary elements are completely forgotten.

#### 4.0.10 Retroactive inhibition and implicit memory

*J. Krems, University of Regensburg, Germany*

It has been well established that interference manipulations (e.g., retroactive inhibition) determine performance in explicit memory tests like free or cued recall. For implicit memory of new associations, however, by means of word-stem completion techniques no retroactive interference could be found (Graf & Schacter, 1987). To clarify if this dissociation remains also when learning lists of familiar words, in two experiments memory performance in explicit and implicit versions of a category-production test and a newly developed word-image completion procedure was compared.

In both experiments the reproduction instructions and the interference condition were varied. The design was a  $2 \times 5$  factorial with type of test (explicit or implicit) and interpolation level (1–5 lists learned) as between-subjects variables (4 seconds/word; 1 trial). Each list contained 36 items: 26 selected from 4 categories (e.g., fruits) and 10 distractor items. The test phase followed immediately after the study.

In the first experiment a category-production test was used. After the study phase, subjects (84 students) were given 10 category titles one at a time. For implicit memory subjects were asked to produce spontaneously as many examples belonging to a category as possible. In the explicit version they were instructed to name as examples only study-list words. An independent control group of 10 subjects received the implicit instruction but without a study phase.

In the second experiment a word-image completion procedure was used as a memory test. Immediately after studying one to five lists, the subjects (64 students) were informed that they would be shown fragmented word images, which would be complemented successively. They were instructed to identify the word as fast as possible. In the explicit condition only study-list words should be named. 39 words were presented (13 from study-list one, 13 from lists 2 to 5, 13 distractor items). Starting at zero percent, three percent of the pixels of a word image were added every 300 ms.

The results of both experiments showed higher memory performance in explicit than in implicit tests. A general priming effect was also found. Retroactive interference effects were only found in the explicit versions of the category-production test but not in the word-image completion procedure. The rate of forgetting in implicit tests is slower than in explicit tests. In general, the results support the idea of different forms of memory.

#### 4.0.11 Semantic pre-activation from titles during language comprehension

*J.-F. Le Ny and G. Verley, University of Paris-Sud at Orsay, France*

Subjects were presented with sentences followed by a title probe word and were instructed to recognize/accept these as semantically related, or not, with the sentence. Response times were registered and interpreted as an index of the activation level of a part of the semantic representation in memory, according to activation (or symbolic-connectionist) models of comprehension. Events, or circumstances of the events, described in the sentence were probed separately. The sentences were, or were not, preceded by a title word, which could be congruent or incongruent with the probe. The main assumption was that these titles, when present, would increase the activation level of the corresponding parts of the semantic representation and, consequently, shorten the corresponding response times. Evidence for this main effect was found, as well as for derived ones concerning inhibition and elective decay in memory.

Activation (or symbolic-connectionist) models of language comprehension assume that representational units in memory, in particular lexical ones, are activated at various levels during comprehension. Response times collected in immediate or short-term probing (word recognition) can be used as an index of these levels: they are assumed to vary as a function of the current activation levels affecting corresponding parts of the semantic representation just built in memory. In our experiments, probe words were not new tokens of words presented in the experimental items, as in pure recognition experiments—i.e. verbatim repetitions of previous words, conventionally considered as “old” stimuli—but semantic probes, in this case title words summarizing a part of the information conveyed by the sentence. This procedure, which uses a mixture of semantic acceptance and pure recognition processes, seems to eliminate any role of morphologic information in memory and to warrant the semantic nature of the representation probed. In this experiment, items were single sentences. Probe words pointed to either the *event* reported by the sentence core, or its *circumstances*, reported by the adjuncts. Two versions of each item were used, reversing two parts of the sentence in order to probe the semantic representation at two different short delays after processing of the relevant information, as usual in our experiments.

An example of two symmetrical items is approximately (word for word translation from French, conserving word order): “after the last hedge before the stands the favourite jockey was suddenly thrown by the horse”,

or “the favourite jockey was suddenly thrown by the horse after the last hedge before the stands”. The probe words could be “fall” or “tiers”. Negative items, i.e. sentences followed by words unrelated with them, were interspersed among positive ones and used as foils.

An additional assumption of the mentioned models is that activation spreads in subject memory as a joint function of semantic proximity between units in the concerned area of the semantic network and current information input, grasped from the text and partially processed. This study then investigated the issue: does introduction of relevant information just before a sentence produce shortening of response times to the probes, which could be interpreted as pre-activation (or priming) of these semantic probes, i.e. increase of the activation level affecting the concerned part of the representation built during comprehension? This factor was here studied in relation with a focusing, attentional factor, investigated in another way in parallel experiments using underscoring.

In this experiment, title words or phrases were presented before the sentences, thus yielding antecedent preparatory information. These titles also pointed either to the event or to the circumstances to be presented later, but they were different from the title words used as probes, and more specific than these. Examples of antecedent titles are either “horse accident” or “in front of the people”, which were used for the sentence quoted above. Such experimental items thus were made very similar to short news presented in newspapers. Control items had no antecedent title.

The experiment was run according to our usual probing procedure, involving presentation of the text (here the sentence) on a monitor screen, followed by the probe word. Subjects were instructed to press a “yes” or “no” key on the keyboard according to whether they accepted, or not, the probe word as a title for the previous sentence. The design involved two delays of probing (order A or B of the sentence parts), two types of probe words (*event* and *circumstances*), and three types of antecedent titles (*event*, *circumstances*, or nothing), which created three values of the relation of congruence between the antecedent title and the probe (congruent, incongruent, null). The experiment was run in two similar successive phases, and the material of the second phase was constructed by re-shuffling the sentence-title combination.

The major results were as follows: (1) Presence of a congruent antecedent title consistently produced response times shorter than no title; an incongruent title produced longer response times only during the first phase. These results were evidence for pre-activation or pre-inhibition processes. (2) Response times were consistently shorter for the probes pointing to the event than for those pointing to the circumstances; this is a confirmation of previous results. (3) There was an elective mnemonic decay (i.e. response



times increased more for circumstances than event probes, which is also a confirmation of previous results in our experiments), but only for items with no title or an incongruent title before. No such effect was found for items containing congruent titles; this absence was observed for circumstances as well as event probes. This result is interpreted as a manifestation of an increase in *importance* of the repeated and focused information, which prevents short term mnesic decay.

Generally, these results are interpreted as being in agreement with predictions drawn from our activation (symbolic-connectionist) model of comprehension.

#### 4.0.12 Cognitive effort and reality monitoring

*J. M. Lopez-Frutos, I. Cuevas, and J. M. Ruiz-Vargas,  
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The aim of this research was to assess the role of cognitive effort in the process involved in discriminating between externally generated and internally generated memories, which is called *reality monitoring* (Johnson & Raye, 1981). Our hypothesis was that the success or failure of reality monitoring is dependent on the greater or lesser richness of attributes of memory traces. In this regard, we postulated that if cognitive effort plays a relevant role on the encoding of information (whether internal or external), then it will help discriminate the origin of the source. Two experiments were carried out. Each experiment included a manipulation of cognitive effort (high and low) and the origin of the source (external and internal). A significant effect was obtained for both the effort variable and the source variable. As Johnson, Raye, Foley and Foley (1981), we did not find a generation effect in the discrimination task. This finding may be related to differences in the nature of the encodings between external and internal sources. Failures in discrimination of internal source seem to be related to recognition deficits; however errors of external source discrimination were correlated with recognition. Moreover, these results showed that cognitive effort increases accuracy of reality monitoring (Bentall, Baker, & Havers, 1991). They are further discussed in terms of distinctiveness and elaboration of memories.

#### 4.0.13 The effect of simultaneous and successive presentation on global and local analysis of rotated letters

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Several studies (Navon, 1977, 1981; Martin, 1979; Hoffman, 1980; Pomerantz, 1983; Stablum, 1989; Rumiat, Nicoletti, & Job, 1989; Marucci, Pessa, De Pascalis, & Carmosini, 1990) have shown a decrease in response time when subjects are requested to analyse the global characteristics of the stimulus. On the contrary, response time is generally found to be longer in the local analysis of visual configurations. These results have been explained by postulating an increased cognitive effort and a more detailed processing of perceptual information. In the case of local analysis this processing seems to take longer to provide a response. However, the effect of different presentation conditions of the stimulus on the prevalence of global analysis rather than local analysis need to be examined more closely.

We carried out two experiments to study the influence on local and global analysis of simultaneous and successive presentation of pairs of letters during visual comparison tasks by assessing similarities and differences. In Experiment 1 on 36 subjects, 384 stimuli (F or H), each formed by a large capital letter constructed from small capital letters, were presented in pairs, simultaneously. The small capital letters could be equal to or different from the large one. When the large and the small letters were the same, the stimulus was said to be "consistent"; when the letters were different, the stimulus was said to be "inconsistent". Each pair was presented for 700 ms and was balanced for the consistency and inconsistency factor. The left member of the pair was always exposed in an upright position (0 deg), whereas the right member, as suggested by Shepard's mental rotation paradigm, was presented at different angular positions (0, 60, 120, 180, 240, 300 deg). The subject's task was to judge as soon as possible if both letters of the pair were the same or different. The correct RT data were used for a three-way repeated-measures ANOVA in which the factors were Analysis (global or local), Response (consistent or inconsistent), and Angular Position (0, 60, 120, 180, 240, 300 deg). A main effect of the Analysis ( $F(1, 35) = 148.66, p < .001$ ) was found, with a higher speed of the reaction time for the global level than for the local level (respectively,  $M = 868, SD = 216$  vs.  $M = 1259, SD = 310$ ). Moreover, a significant effect of the Angular Position ( $F(5, 175) = 3.89, p < .002$ ) was shown with the slope of the reaction time function similar to that obtained by Cooper (1975) and Cooper and Shepard (1973). These results are consistent



with those found by Robertson and Palmer (1983) and confirm the priority of the global processing. During the simultaneous presentation of the stimulus pair the global analysis of the letter depends on the perceptual processing that in this condition is prevalent in respect to the other kinds of elaboration.

In Experiment 2 we examined the validity of the hypothesis concerning if the global analysis is prevailing also in the successive presentation condition of the letters of each pair. Subjects were the same who participated in Experiment 1. 192 letter pairs (E or K) were used. Each stimulus was a large capital letter constructed with small capital letters and was consistent or inconsistent, as for the letters used in Experiment 1. Each member of the pair was presented for 300 ms by a slide-projector controlled by an electronic tachistoscope. The ISI between the first and the second letter of the pair was 1000 ms. The first member was always presented in an upright position (0 deg), whereas the second member was exposed at different angular rotations, in the same way as in Experiment 1. The subject's task was to judge as soon as possible if the second member of the pair was the same or different in respect to the first member. RTs were recorded. A three-way repeated-measures ANOVA, identical to that performed in Experiment 1, was carried out on the correct RTs. The significant source was the main effect of response ( $F(1, 35) = 14.51, p < .001$ ). Responses to "consistent" stimuli were faster than responses to "inconsistent" ones. A significant effect of angular position was found ( $F(5, 175) = 6.60, p < .001$ ), with RT describing a monotonic function similar to that obtained by Shepard and his colleagues. Moreover, analysis and response factors showed a significant interaction ( $F(1, 35) = 15.67, p < .001$ ). During global analysis, responses to "consistent" stimuli were faster than responses to "inconsistent" stimuli. Finally, a significant interaction between analysis and angular position was shown ( $F(5, 175) = 3.07, p < .01$ ). A main effect of the analysis factor has not been shown. This last result, different from that obtained in Experiment 1, may be due to the influence of the representation in memory of the first pair member, which probably undergoes transformations and acquires different characteristics from those pointed out during the visual-perceptual processing. The hypothetical transformations may have significantly influenced, in successive presentation, the global and local analysis and may be due to the predominant influence of memory traces. Finally, these results are discussed in the light of a model that postulates a temporal precedence of the global information over the local one at the perceptual level and of Shepard's mental rotation paradigm.

#### 4.0.14 Knowledge of cognition, regulation of cognition, and affective structure

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Two experiments investigated the relationship between affective structure and two aspects of metacognition: knowledge of cognition (i.e., accuracy of predicting one's ability to perform cognitive tasks) and regulation of cognition (i.e., allocation of cognitive resources in strategy planning).

Experiment 1 examined whether university students who accurately evaluate their own cognitive abilities are also able to plan cognitive strategies in a better way as compared to students who show inaccurate self-knowledge. Knowledge of one's cognitive abilities was assessed through a questionnaire and its accuracy was measured as the correspondence between self-ratings and performance in cognitive tasks. Results showed that accuracy of self-knowledge is a relevant factor for accurate planning of cognitive strategies.

Experiment 2 addressed the same topic exploring the relationship between affect structure (i.e. positive/negative affect) and the role of self-knowledge accuracy on strategy planning during study. Affective structure was examined through the PANAS Scale which provides reliable independent measures of the positive/negative affect. Results showed that subjects with a prevalent negative affect are less skilful than subjects with a positive affect on both self-predictions and strategies planning.

#### 4.0.15 Long term memory for visual episodes in the first 6 months of life

*O. Pascalis and S. de Schonen, Cognitive Neuroscience Laboratory, CNRS, Marseille, France*

Little is known about long term episodic memory in infancy. Neonates show habituation/dehabituation effects with visual stimuli and a visual preference for their mother's face over a stranger's face. The experimental conditions under which these abilities have been demonstrated have involved only very short term memory however. It has been claimed on the basis of Fagan's data obtained in the seventies with a familiarization technique that before the age of 6 months, long term memory can only be a procedural memory but neither an episodic, nor a declarative memory. The operant conditioning technique used by Rovee-Collier to demonstrate the existence of a long term memory for simple geometric shapes in 3-month olds is ambiguous. It is possible that the operant technique used by Rovee-Collier may involve different memory mechanisms from those involved in the habituation/dehabituation technique. Squire (in press) has recently shown that

amnesic patients with a hippocampal lesion do not show any novelty effect after a familiarization period followed by an interval of two minutes, whereas normal adults do. Do infants younger than 6 months show dehabitation (novelty effect) after an interval of 24 hours?

In our experiment, 2-, 3- and 6-month old infants were successively presented with photographs of the same face in 3 different poses. The subject was visually habituated to this face with an infant-controlled procedure. Once the habituation criterion had been reached, a memory test was presented to one half of the subjects two minutes after habituation, and to the other half twenty-four hours later. In both cases (2 min and 24 h), a fourth photograph of the familiar face and that of a novel face (in the same pose as the familiar one) were presented simultaneously. The fixation times towards the novel and familiar faces were measured. Both the habituation and the test series were performed at the infant's home in order to minimize the contextual novelty.

The three-month olds, but not the two-month olds, exhibited a preference for the novel stimulus, after an interval of 24 hours. Among the three-month olds, however, only the males showed this preference. The results of a further study strongly suggest that this sex-related difference probably reflects a difference in the infants' face processing abilities rather than a difference in their memory capacities. These results show that three-month olds can update in the long term an episode which they have "passively" experienced previously. They suggest that despite the poor maturation of the human hippocampus at the age of three months, long term memory for visual episodes does exist, as far as some kinds of events are concerned.

#### 4.0.16 The significance of anosognosia and neglect for the prognosis and the effect of rehabilitation in patients with stroke

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**Objective.** To investigate (1) the incidence of anosognosia and neglect in pts with acute stroke and (2) whether these deficits, as it is commonly assumed, worsen the prognosis and make rehabilitation difficult.

**Materials and methods.** 522 consecutive pts with stroke admitted < 1 week after debut were evaluated for anosognosia, neglect and aphasia. They were scored according to the Barthel Index (BI) weekly throughout the hospital stay. The improvement in ADL function expressed by the BI was compared for pts with the left hemisphere symptom aphasia and the right

hemisphere symptoms neglect/anosognosia.

**Results.** 142 had impaired consciousness at the admission. Therefore they could not be evaluated for aphasia, neglect or anosognosia. Of the remaining 380 pts, 378 could be evaluated for aphasia – 30% had aphasia. 314 pts could be evaluated for neglect – 18% had neglect. 298 pts could be evaluated for anosognosia – 15% had anosognosia. 317 pts could be evaluated for anosognosia and/or neglect – 21% had neglect and/or anosognosia. Anosognosia and/or neglect were seen in 16% of the pts with aphasia. Cortical lesions were found in 62% of the pts with aphasia and in 58% of the pts with neglect/anosognosia.

Of the pts who survived, and who was scored according to the BI on admission and discharge (275), the BI for pts with aphasia were  $65 \pm 36$  respectively  $80 \pm 32$  points and for pts with neglect/anosognosia were  $50 \pm 33$  respectively  $76 \pm 30$  points. In pts with aphasia (70) BI had increased by  $15 \pm 23$  points, whereas the increase in BI for pts with neglect/anosognosia (36) was  $26 \pm 27$  points ( $p = 0.03$ ).

**Conclusion.** Anosognosia and neglect are more common with cortical than with subcortical lesions and is found in 15% respectively 18% of the pts who can be evaluated in the acute stage. Pts with the right hemisphere symptoms anosognosia and neglect do *not*—as commonly assumed—have a poorer prognosis or less effect of rehabilitation compared to pts with the left hemisphere symptom aphasia.

#### 4.0.17 Subjective a priori and posterior assessments of success: The awareness of "bad and clear" periods of vision

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A comparison between a priori and posterior self-evaluation of performance in a recognition task revealed two groups of subjects. In the first group there was no correlation between the two assessments. This means that although subjects were aware of the "bad vision" period onset, they were not able to improve their performance. In the second case it was possible. The reaction time (RT) and decision doubts latency (DL) analysis showed in the second group the artificial delay of the beginning of the breathing cycle.

Two kinds of decision errors were described: omissions and false alarms. The average levels of a priori doubts for these cases were 54 and 57%, respectively. For posterior doubts, the levels were 16 and 31.8%. For correct target recognition, a priori doubts maintained 49.4% with posterior doubts level 29.4%. For passive correct reaction, when the signal was absent, the

indices were 49.5 and 20.8%, respectively. It is clear that active suggestions like correct detections and false alarms differ from passive ones.

The passive decisions, however, should be separated into at least two different classes. One of them is "occasional" correctness, so for further analysis the  $d'$  and  $d''$  statistics were more adequate (Tatko, 1991). This proved the main conclusion dealing with independence between the subject's external and internal observation psychophysics indices.

The analysis of RT and DL combinations by a "linguistic-like decoding program" (Tatko, 1992) did not show any significant relation between the tactics and strategy of the decision and instruction modification or nomination by the subject of the appropriate stimulus combination as a target.

The interpretation of the results suggests the ability of certain people to use breath stopping for changing the temporal course of "clear-slipshod" vision periods. This may form the basis for learning individuals with inborn inability to use a priori prognosis.

#### 4.0.18 On the spatial representation of time concepts in reasoning tasks

*G. De Vooght and A. Vandierendonck, University of Ghent, Belgium*

According to the time-spatialisation hypothesis, temporal concepts and relations between events are represented in a spatial format. Vandierendonck and De Vooght (1992) reported some experiments in which reasoning on temporal and on spatial contents was compared in order to test this hypothesis. Although some of the findings were encouraging for this conceptualisation of temporal representation, other aspects of the data evoked suspicion about the correctness of this formulation.

In the present paper, experiments are reported in which subjects perform temporal and spatial reasoning tasks, while performing another task which has disrupting effects on certain components of the working memory system. The findings of these experiments are presented and discussed with respect to (a) the time-spatialisation hypothesis, (b) Johnson-Laird's (Johnson-Laird & Byrne, 1991) mental models theory, and (c) Baddeley's (Baddeley & Hitch, 1974) working memory model.

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