Keynote Lectures

Monitoring the correctness of our own knowledge: Subjective Confidence and its accuracy

Asher Koriat
University of Haifa, Israel

Confidence judgments have been used in many research domains, in part as a tool to aid in modelling cognitive processes. But what is the basis of subjective confidence in our knowledge and judgments? Why are confidence judgments generally accurate in discriminating between correct and wrong responses? These questions have concerned philosophers and psychologists. A self-consistency theory will be presented for the basis of confidence judgments and their accuracy. It assumes that the process underlying subjective confidence in general-knowledge questions and perceptual judgments has much in common with that underlying statistical inference about the outside world. Participants behave like intuitive statisticians who attempt to reach a conclusion about a population based on a small sample of observations drawn from memory. Reliability is used as a basis of validity and therefore metacognitive accuracy depends heavily on cognitive accuracy: The confidence / accuracy correlation is positive only when people's cognitive performance is largely correct, but is negative when people are largely in error. Results consistent with the theory were obtained across many domains, and the theory was shown to have implication for several issues including social conformity, group decisions, and the wisdom of crowds.

Transparent research practices:
Past roots, present revolution, and future prospects

Eric-Jan Wagenmakers
University of Amsterdam, Netherlands

In the past few years, psychological science has undergone a paradigmatic revolution. This revolution is the direct consequence of a "crisis of confidence", the increasing realization that many published findings may be fiction rather than fact. The first part of this presentation provides some historical background and describes the defining events that have caused the revolution ("the straws that broke the camel's back"). The middle part of this presentation discusses the current changes and initiatives that seek to promote openness and align the incentives for the field ("truth-finding") with those for individual researchers ("publish, not perish"). The final part of this presentation outlines a vision for the future, illustrated with a hypothetical example: the perfect experiment.

Experimental evidence for major emotion theories:
A comparative survey

Klaus Scherer
Ludwig-Maximilians-Universität München
& Swiss Center for Affective Sciences, Geneva, Switzerland

The field of emotion has been, and still is, beset by the large number of competing theories (by some counts – several hundreds), generating endless conceptual and methodological difficulties, not the least being the problem of agreeing on a common definition of what an emotion is. Even more serious is the problem of agreeing on what constitutes sufficient evidence that supports a particular theory, justifying to continue paying attention to it. This situation is rendered even more problematic by the fact that most theories do not propose clear predictions or hypotheses that lend themselves to empirical operationalization, let alone to systematic experimental testing. In this keynote, I will attempt to survey some of the major theories in the field with respect to the amount of experimental evidence (in the wider sense) it has generated and discuss the issue of whether all theories are created equal with respect to experimental testability. In so doing, I will specifically focus on the issues of lawful mechanisms and different types of cause-effect relationships.

Contributions

Collaborative memory revisited: Does collaboration at test always decrease recall?

Magdalena Abel & Karl-Heinz T. Bäuml

University of Regensburg

Recall is reduced in collaborating groups compared to nominal groups, in which the nonredundant responses of individually working subjects are cumulated to simulate a group`s potential. This effect, termed collaborative inhibition, is attributed to the disruption of idiosyncratic retrieval strategies when one is exposed to other responses during collaboration, similarly to how presentation of part of a previously studied list as retrieval cue results in memory impairment. Yet, recent studies suggest that exposition to such part-list cues may not always be detrimental, but can in fact be beneficial for memory performance – at least in situations in which access to the original encoding context is impaired and needs to be reinstated. In two experiments, we investigated whether collaborative remembering always results in collaborative inhibition, or whether being exposed to other participants` responses may, in parallel to part-list cueing, also be beneficial under certain circumstances. In both experiments, subjects recalled lists of unrelated items either individually or in collaborating triads. In Experiment 1, context access was manipulated by applying short and long retention intervals; in Experiment 2, a directed forgetting task was applied instead, in which subjects are asked to remember or forget a previously studied list. When context access was intact (after a 5 min delay in Exp. 1 and a remember cue in Exp. 2) recall was impaired in collaborative compared to nominal groups. However, when access to the encoding context was impaired (after a 24 h delay in Exp. 1 and a forget cue in Exp. 2) no such collaborative inhibition emerged. The results indicate that collaborative remembering does not always result in collaborative inhibition. Moreover, the data suggest that there may be certain parallels (but also differences) between part-list cueing and collaborative remembering.

Adaptive advice taking? Seeking and using advice in different information ecologies

Fabian Ache & Mandy Hütter

Eberhard-Karls-Universität Tübingen

Advice taking constitutes an important aspect of human adaptive decision making. Previous research demonstrated egocentric discounting. That is, people underweight advice when revising their judgment and thereby fail to realize optimal gains. One account of this phenomenon assumes people to possess more knowledge in support of their own as compared to other people’s judgments. However, previous research never provided people with the opportunity to compensate for these skewed information samples, for instance by consulting additional advisory estimates. We expand this approach by assuming that, (1) given the opportunity, people will sample additional information, (2) this sampling is sensitive to features of the information ecology, and (3) people will be sensitive to the sampled information when

revising their judgment, relying more strongly on advice that was supported by additional information. To test these assumptions, we expanded the classical research paradigm by a sampling phase that allowed participants to sample any number of advisory estimates. Two studies show that (1) participants sample substantial amounts of additional advice, (2) that the sampling frequency increases when advice diverges from their initial judgments, and (3) that sampling frequency increases the degree of advice utilization. A third study replicated these findings even when advice was costly to obtain. Strikingly, costly as compared to free advice even increased participants' sensitivity to the information ecology. The sampling approach's implications for our understanding of advice taking and its consequences for theorizing will be discussed.

Strategic sexual signals: Women's display and avoidance of the color red depends on the attractiveness of an anticipated interaction partner

Maria Agthe[a], Daniela Niesta Kayser[b], Sascha Schwarz[c] & Dieter Frey[a]

[a] Ludwig-Maximilians-University of Munich, [b] University of Potsdam, [c] University of Wuppertal

The color red has special meaning in mating-relevant contexts. Wearing red can enhance perceptions of women's attractiveness and desirability as a potential romantic partner. Building on recent findings, the present study examined whether women's choice to display the color red is influenced by the attractiveness of an expected opposite-sex interaction partner. Results indicated that female participants who expected to interact with an attractive man displayed red (on clothing, accessories, and/or makeup) more often than did participants who expected to interact with a rather unattractive man or participants in a naturalistic baseline condition. Moreover, women expecting to interact with a rather unattractive man displayed red less often than did women in the baseline condition. Findings are discussed with respect to evolutionary and cultural perspectives on mate evaluation and selection. Moreover, we attend to exploratory analyses regarding possible hormonal influences on women's display of red as a subtle behavioral indicator of communicating romantic interest.

Variations in cholinergic and dopaminergic genes influence nicotine effects on attention processes

Stefan Ahrens[a], Oliver Behler[a], Anja Gieseler[a], Sarah Querbach[a], Carsten Giessing[a], Sebastian Markett[b], Thomas Breckel[a], Martin Reuter[b] & Christiane Thiel[a]

[a] Carl-von-Ossietzky Universität Oldenburg, [b] Universität Bonn

Reorienting of attention and distractor processing can be modulated by administration of the cholinergic agonist nicotine, although interindividual variability is quite high. We therefore investigated whether genetic differences in cholinergic and dopaminergic receptors can account for this variability. Subjects were genotyped for single nucleotide polymorphism (SNP) rs1044396 in the gene coding for the nicotinic acetylcholine receptor subunit a4 (CHRNA4) and

SNP rs6277 within the dopamine receptor type d2 gene (DRD2). In two double-blind within-subject pharmacogenetic studies we administered a 7 mg nicotine patch or placebo patch to healthy nonsmokers 1 hour prior to performing different attention tasks. First in a behavioural study, distractor processing was investigated in a selective attention paradigm ("Lavie task") in 58 subjects and in a second MRI study reorienting was tested in 50 participants with a Posner paradigm. We found in both cohorts a synergistic effect of CHRNA4 and DRD2 genotype on the nicotine effect with one combination (CHRNA4 CC/CT & DRD2 CC) showing enhancement in performance. In addition subjects could be classified into genotype groups based on brain activity in pulvinar, striatum, frontal cortex, precuneus and middle temporal gyrus using a partial least squares discriminant analysis. Our findings point out that variations in cholinergic and dopaminergic transmitter systems account for interindividual variability of nicotine effects.

Statistical learning for psychologists

Johannes Albert-von der Gönna

Ludwig-Maximilians-Universität München

The collection and retrieval of information in ways as described in this symposium will inevitably lead to ever increasing data sets for psychologists to deal with. Fairly recent developments in statistics and computer science, collectively known as machine/statistical learning or predictive modeling, provide novel means to gain insights from such data (e.g. Bishop, 2008; Hastie, Tibshirani & Friedman, 2008).These modeling techniques not only aim for accuracy in prediction, but can also provide valuable information on the relevance of certain predictors (or features) in a given context. The former is generally achieved by not only fitting a model on a given data set, but by using different resampling methods (e.g. cross-validation, bootstrapping) to validate (and generalize) a model`s scope (Bischl, 2012; Simon, 2007). Typically, several competing models are fitted and evaluated this way (Kuhn & Johnson, 2013), some of them more familiar to psychologists (e.g. regression models) than others (e.g. random forests, support vector machines). The role of particular predictors may, amongst other strategies, be evaluated by reducing model complexity applying regularization and shrinkage methods. Several such techniques have been introduced extending the least squares regression estimate usually fairly well known by psychologists, namely ridge regression (Hoerl, 1970), the lasso (Tibshirani, 1996) and the elastic net (Zou & Hastie, 2008).This talk will provide an introductory overview of these modeling techniques and general statistical learning procedures like resampling. A moderately sized data set of some 700 occupational trainees will be used to highlight the need for and inherent value of statistical learning approaches by revisiting the use of detailed measurements of individuals for employee selection.

An exemplar-based random walk model for quantitative estimation

Rebecca Albrecht[a], Bettina von Helversen[a], Janina A. Hoffmann[b], Timothy J. Pleskac[c] & Jörg Rieskamp[a]

[a] University of Basel, [b] University of Konstanz, [c] Max Plank Institute for Human Development Berlin

Many judgment tasks include quantitative estimations of a criterion given multiple cues. For example, estimations of house prices may depend on the quality of a neighborhood or the number of rooms. Past research proposed that people retrieve similar exemplars from memory to make such quantitative estimations. Exemplar models have been shown to predict participants' judgments well in tasks with a non-linear dependency between cues and criterion, however they are silent in terms of response times. One solution to this limitation is sequential sampling models, which do quite well in explaining choices and response times in two-alternative forced-choice tasks. In contrast, quantitative estimation requires participants to consider and select an estimate from a large number of possible values that often have a metric interpretation. Our solution is a modification to an exemplar-based random walk model. The model assumes that evidence is accumulated by sequentially retrieving exemplars from memory. Each exemplar presents evidence for a specific criterion value. This evidence is added to an accumulator corresponding to the specific criterion value, but also contributes to neighboring accumulators. The degree of contribution is determined by a Gaussian kernel centered over the criterion value of the retrieved exemplar. The random walk stops once an accumulator reaches a threshold. The model predicts response times and accuracy as a function of the exemplars stored in memory. Judgments are more accurate, if the criterion values of similar exemplars are close to the correct criterion. Further, people respond faster the more similar exemplars have been encountered with the same criterion value. In addition, the model predicts an inverted U-shaped curve over the response scale, with estimates being faster and more accurate on the edge of the scale. Statistical analyses of the model show a high correlation with human estimation errors and response times.

The cost of awareness: Attentional blink or awareness blink?

Eyal Alef Ophir[a] & Dominique Lamy[b]

[a] Tel Aviv University / Charite Berlin, [b] Tel Aviv University

Conscious perception of an event has long been associated with favorable processing of that event. However, recent findings from our lab has shown that conscious perception may also come at a price for subsequent stimulus. Under the exact same stimulus conditions, observers are much slower at responding to a target when a cue that precedes it is consciously perceived than when it is not. We suggest that this cost reflects a processing limitation that is unrelated to an attentional bottleneck or a response selection limitation but instead emerges in the aftermath of the conscious perception of an event. Here, we demonstrate that this cost reflects a perceptual limitation that is independent of attention. We show that when one experiences an event consciously, perceiving a second event is impaired if it follows the first event by less

than half a second or so – even if this event occurs at an unattended location. Relying on the similar time courses of the two costs, we suggest that attentional blink findings may be accounted for (at least in part) as an "awareness cost" rather than as an attentional limitation.

Binocular rivalry: From emotion to psychopathology

Georg W. Alpers & Antje B.M. Gerdes

University of Mannheim

Preferential perception of emotional cues will help an individual to respond quickly and effectively to relevant events. The preferential perception of visual emotional cues is particularly impressive under conditions where different cues compete for perceptual dominance. When two incompatible pictures are presented to one eye each, this competition results in a perceptual alternation between the pictures, such that only one picture is visible while the other is suppressed. This so called binocular rivalry involves different stages of early visual processing and is thought to be relatively independent from intentional control. Several studies from our laboratory showed that emotional stimuli predominate over neutral stimuli in binocular rivalry. In healthy participants, emotional facial expressions as well as pictures of emotional scenes predominate over neutral ones. We used probes to control for possible reporting biases and conditioned cues to control for possible differences in physical features. In patients with a specific phobia (spiders), phobia-related material dominates over neutral content more than in non-phobic control participants. Lastly, we will report on mixed results with disorder-specific word stimuli. Taken together, data from this paradigm demonstrates that emotional pictures are perceived more intensively and that psychopathology can influence preferential perception.

The role of the evaluative information ecology for social comparison processes

Hans Alves, Alex Koch & Christian Unkelbach

Universität zu Köln

We identify to crucial properties of evaluative information environments, namely diversity and frequency. First, negative information is more diverse than positive information. In person perception for example, there are many more ways to be disliked than to be liked which is why liked persons are perceived as highly homogenous (Alves, Koch, & Unkelbach, in press). Second, positive information occurs more frequently than negative information. In person perception, as most people behave according to the norms (positively) most of the time, people's mental representation of their social world is predominantly positive as well. Both principles, the larger diversity of negative information, and the higher frequency of positive information have intriguing implications for social comparison processes. One important implication is that similarities amplify, while differences attenuate positivity. That is, people's shared features are more positive than their unshared features (Alves, Koch, & Unkelbach, in prep). In general, what

people have in common is strongly positive, while negative attributes make people unique. As a result, cognitive processes which build on similarities such as integration/inclusion lead to more positive evaluations than cognitive processes which build on differences such as differentiation/exclusion. For example, as choices can only be made based on differences, the overall evaluation of choice options might suffer from the decision process itself. Further, as stereotypes are formed to distinguish social groups, they typically highlight groups' unshared attributes, i.e. their differences. If differences are necessarily more negative, the negativity of stereotypes and intergroup bias in general might arise from the need to distinguish groups within a predominantly positive world that displays a large diversity of negativity. We present data from three lines of research that tested the role of the information ecology for social comparison processes.

Research Assistant - A mobile data collection and analysis framework

Ionut Andone

Rheinische Friedrich-Wilhelms-Universität Bonn

In recent times, mobile technology has evolved at an astonishing pace and has permeated into all the aspects of our lives. Unfortunately it still has not been adopted at a large scale in certain areas of research, such as psychology and other human behavioral fields. Data is usually collected in these areas by interviewing participants or by self-reporting. These methods consume a lot of time from the interviewers, capture only a small fraction of the participants' lives or are prone to error or bias due to the human nature. The number of participants is limited by the resources available and in the case of few participants, may also introduce selection bias. In order to reach a wider population range, a better method of data gathering, and a faster information retrieval and analysis cycle, there needs to be a different approach. We have developed a framework for data collection and analysis that is easily deployable and cost-effective to operate. Since smartphones are ubiquitous in our lives and are full of data collection sensors, our solution takes advantage of this by being deployed as a mobile application. The reduced control over the participants in the experiment is traded-off for a larger sample of the population and data. The application is customizable to the researchers' needs and is made freely available through the mobile platforms' marketstore (Google Play Store, Apple Store). Data collection starts, once the participants install the app and register for the experiment, and then it is transmitted securely to our servers. Researchers can download the data into their preferred format and they can also analyze it on our platform by leveraging different programming languages (R, python, etc.). The project will follow specific IRB/IEC/ERB/REB requirements of the researchers' projects. By providing this framework we hope to advance all the fields of research where data collection and faster analysis could be improved by it.

An explorative case study of representational change in problem solving

Benjamin Angerer[a], Cornell Schreiber[a] & Stefan Schneider[b]

[a] University of Vienna, [b] University of Osnabrück

From our everyday experience we know that both, the initial construal of a problem and the ongoing search for better representations are non-trivial processes. Yet, many tasks employed in problem solving research are rather easily understood and reasoned about – the problems' straight-forward structure preempting the subjects first having to find adequate representations. Consequently, we still do not know a lot about how task and problem representations come about and change. Since the highly idiosyncratic dynamics of these processes make it difficult to investigate them with standard methodology, we conducted an extensive, exploratory case study, gathering verbal protocols with a carefully designed introspection method. In this study it was investigated how a subject construed an underspecified description of a complex imagery manipulation task (paper folding), how they came up with a first representation and how their representations evolved over multiple daily sessions. The task was chosen to allow a wide variety of representing problem states, goals and operators, while still having well-defined solutions. The task complexity was chosen to keep cognitive load on a level where the subject is compelled to look for better representations. We present preliminary results from protocol analysis and discuss the relative merit of three theoretical frameworks for analysis and theory formation: Classical problem space theory based on Newell & Simon's work (1972), DiSessa et al.s "Knowledge in Pieces" approach (1988), and Wiener's psychology of thought (Eder & Raab, 2015).

Time on task and pause effects on theta and alpha power

Stefan Arnau & Edmund Wascher

Leibniz Research Centre for Working Environment and Human Factors

The ability to maintain attention during prolonged periods of cognitive activity is of great importance in everyday life. However, such prolonged periods of cognitive activity may lead to a state of mental fatigue, which is associated with deterioration in task performance and a general aversion to continue the activity. As a psychophysiological marker of mental fatigue, a greater power in the lower frequency bands of the EEG has been reported. In order to investigate the temporal dynamics of the spectral power in the lower frequency bands a group of younger and a group of older adults performed a Simon task for about 3 hours in an EEG study. The experiment also included pauses, so that time on task effect on the one hand and effects of pauses on the other hand could be observed. The results show an increase of frontal theta and alpha power as a function of time on task and a decrease of theta and alpha power as an effect of pauses. The effects of pauses seem to be of transient nature, just being present immediately after the pause. A significant pause effect could also be found for event related spectral dynamics (ERSPs) for frontal theta, where post-pause ERSP was higher than pre-pause ERSP. Frontal midline theta is associated with cognitive control mechanisms and an increase in frontal theta power has been linked to an increase in cognitive demands and higher mental

effort. Therefore the effects of time on task may be interpreted as a manifestation of higher demands due to either a depletion of cognitive resources or a decline in motivation. The fact that time on task and pause effects were more pronounced in the group of older adults compared to younger adults suggests that the underlying mechanism is more likely to be a depletion of cognitive resources.

Acoustic speech learning without phonemes: Identifying words isolated from spontaneous speech as a validation for a discriminative learning model for acoustic speech learning

Denis Arnold, Florence Lopez, Tino Sering, Fabian Tomaschek & Harald Baayen

Eberhard-Karls-Universität Tübingen

In the current study, we trained a naive discriminative learning model to discriminate words based on acoustic cues from spontaneous speech. As a resource, we used the German Conversation Database (GECO v1.0). The corpus contains roughly 20 h of spontaneous speech and provides an automatic word annotation for each audio file. There are roughly a 250 000 words labeled in the corpus. For every single word in the corpus, we created discretized acoustic cues. Our model learned the associations between these cues and the words. Being used as an identifier, it identified 20.6% of the words correctly. To evaluate the performance of the model, we had 500 randomly sampled items from the corpus judged by adult native speakers of German in a listening task. Subject responded whether they actually heard a German word (yes/no) and provided in written form what item they heard. For the latter, we calculated letter distances between the label as provided by the corpus and the subject´s actual answer. We furthermore collected response times for both, the yes/no task as well as the written answer. Subjects were able to identify 29.3% of the words according to the labels in the corpus. 44.9% of the responses have a distance of 1 or less to the label. Model parameters like a word´s activation and rank show significant correlations with the behavioral data like reaction times and letter distances. We summarize that our approach shows great potential given the small amount of language experience the model has compared to 18+ years of each of our subjects.

Empirical validation of the diffusion model for recognition memory and a comparison of parameter-estimation methods

Nina R. Arnold[a], Arndt Bröder[a] & Ute J. Bayen[b]

[a] University of Mannheim, [b] Heinrich-Heine-Universität Düsseldorf

The diffusion model has been applied to many binary decision tasks including recognition memory. Various parameters describe aspects of memory quality and response bias. In three recognition-memory experiments, the validity of the model was tested experimentally and analyzed with three different programs: fast-dm, EZ, and DMAT. Each of three central model parameters was targeted via specific experimental manipulations. All manipulations affected mainly the corresponding parameters, thus supporting the convergent validity of the measures.

There were, however, smaller effects on other parameters, showing some limitations in discriminant validity.

Creativity depends on regulatory focus and, more strongly, on regulatory-focus shift

Peter-Samuel Arslan & Klaus Fiedler

Heidelberg University

Going beyond mere replication, the present research aims at systematic validation of the relationship between regulatory focus and creativity. Although uncontested at the theoretical level, empirical evidence for higher creativity under promotion than under prevention focus is less than compelling. For a systematic empirical test, we include a battery of four different measures of creativity, and we develop a new manipulation of regulatory focus, controlling its effectiveness in a manipulation check. Consistent with theory, creative performance was clearly higher under promotion focus than under prevention focus. This basic result was however moderated in a twofold way. First, the impact of the independent variable, both on the manipulation check and on creativity, was most pronounced after a dynamic shift in regulatory focus, compared to a static regulatory focus state manipulation. Second, this effect was mostly due to generative measures of creativity, consistent with the notion that promotion focus facilitates elaborative and assimilative functions of creativity.

Similarities and differences in eye movements during valuation and choice

Nathaniel Ashby & Eldad Yechiam

Technion - Israel Institute of Technology

Eye-tracking is a popular tool for tracing the attentional processes involved in decision making. While eye-movements have been shown to be predictive of both valuations and choices, little is known about the similarities and differences in attentional allocation that might exist within individuals faced with these two types of decisions. The current work fills this gap by investigating the direction and role of attentional allocation in valuation and choice on the level of the individual, allowing for a careful examination of the similarities and differences existing between these two common decision frameworks. Using eye-tracking methodologies we compared individual's eye-movements during valuations of, and choices between, risky prospects consisting of monetary gains and losses. We predicted that valuations would involve greater information search (more fixations and greater decision times) than choices. We also predicted that biases in eye-movements (fixating longer on higher relative to lower outcomes) would impact both valuations and choices, but that the predictive power of such biases would be greater for valuations. Lastly, we predicted that differences in eye-movements (the prevalence of within vs. between option saccades, and a differential focus on outcomes relative to probabilities) during valuation and choice would predict the extent to which bid-choice preference reversals were observed. We found that valuations resulted in greater information

search, and were impacted to a greater extent by biases in attentional allocation, than choices were, suggesting a clearer (more direct) role of attention in valuation than in choice. In addition, we found that bid-choice preference reversals were greatest for individuals who showed different information search patterns during valuation and choice, indicating that at least one common disparity between valuation and choice might be readily explained by differences in information seeking.

Adaptive memory: Animacy processing enhances young children`s retention

Alp Aslan

Martin Luther University Halle-Wittenberg

Recent work with adults has found superior memory for information associated with animate properties than information associated with inanimate properties, a finding that has been explained in evolutionary terms. The present study examined the development of this animacy-processing effect in children. Kindergartners, and younger and older elementary school children were presented with pronounceable nonwords associated with properties characteristic of either humans (e.g., "METU has many friends"), animals (e.g., "PUTI has claws"), and inanimate objects (e.g., "BULA has four corners"), and were asked to rate whether each presented nonword represented a living or nonliving thing. After a retention interval, a surprise recognition test for the nonwords was conducted. Results revealed significantly better recognition of nonwords associated with human and animal properties than nonwords associated with inanimate objects (performance for human and animal nonwords did not differ). Importantly, the size of the animacy-processing effect was equivalent across the three age groups, suggesting no development of the effect beyond kindergarten age. The results are consistent with a functional-evolutionary view on children`s memory, indicating that already young children show prioritized processing of animate entities.

The revelation effect depends on task difficulty and placement

André Aßfalg[a], Devon Currie[b] & Daniel Bernstein[c]

[a] Albert-Ludwigs-Universität Freiburg, [b] University of Calgary, [c] Kwantlen Polytechnic University

In recognition experiments, response criteria are more liberal when a task precedes the recognition probe compared to a condition without task—the “revelation effect.” For example, participants are more likely to claim that a stimulus is familiar directly after solving an addition task (e.g., 234 + 381 = ?) compared to a condition without addition task. According to the discrepancy-attribution hypothesis (DAH) the revelation effect occurs because participants process the preceding task less fluently than the recognition probe, causing a perceived fluency discrepancy. Participants then attribute the discrepancy to familiarity with the probe. In the present work, we tested two predictions derived from the DAH. According to the first prediction, participants should process hard preceding tasks less fluently than easy preceding

tasks, increasing the chance for a discrepancy and, consequently, the revelation effect. In several experiments, participants completed hard or easy preceding tasks, including anagrams (Experiment 1), letter typing (Experiment 2), and the typing of specific arrow-key sequences (Experiments 3 and 4). Consistent with the DAH, hard preceding tasks produced larger revelation effects than easy preceding tasks. According to the second prediction, the discrepancy should disappear if participants have to work on the preceding task while judging the recognition probe. In Experiments 5 and 6, the revelation effect occurred when the preceding task ended before the appearance of the recognition probe. However, the revelation effect was absent when the preceding task appeared during the recognition judgment. Our results support the DAH but pose problems for other hypotheses and formal models of recognition memory.

A summed-similarity account of false recognition in short-term memory

Frederik Aust & Christoph Stahl

University of Cologne

False recognition of items and events is a robust phenonemon often accompanied by strong subjective feelings of confidence. Research on false recognition has informed the study of the structure and processes of episodic memory (Brainerd & Reyna, 2005; Gallo, 2006). Recent research suggests false memories can also be elicited in short-term memory (Atkins & Reuter-Lorenz, 2008; Coane, McBride, Raulerson III & Scott, 2007; Flegal & Reuter-Lorenz, 2014). In episodic memory, false remembrance has been attributed to different processes such as semantic gist as well as interitem associations. It is unclear whether false recognition in short-term memory is due to the same mechanisms that operate in long-term memory. To address this question, we conducted a short-term memory experiment employing word and image stimuli and adopted a model-based approach to investigate the differences and similarities of false recognition in episodic and short-term memory. In a first step, we applied the Conjoint Recognition Model (e.g., Stahl & Klauer, 2008), a common measurement model of false recognition in episodic memory, to assess false recognition effects as indexed by the gist memory parameter. Based on our previous finding that false recognition in episodic memory can be accounted for by global matching memory models (Araujo, Aust & Stahl, 2015), we then used a summed-similarity model to account for the observed effects. Specifically, we tested whether short-term false memory phenomena in response probabilities, as well as RT, can be explained by an adapted exemplar-based random walk model (Nosofsky & Palmeri, 1997; Nosofsky, Little, Donkin & Fific, 2011; Nosofsky, Cox, Cao & Shiffrin, 2014) or a ballistic variant thereof (Brown & Heathcote, 2005; Donkin & Nosofsky, 2012).

Drama therapy improves social skills in children with attention deficit hyperactivity disorder

Solmaz Azizi[a], Seyed Ali Hosseini[a], Hooshang Mirzaei[a], Katayoon Khooshabi[a] & Reza Rostami[b]

[a] University of Social Welfare and Rehabilitation, Tehran, Iran, [b] University of Tehran

Children with Attention Deficit Hyperactivity Disorder (ADHD) suffers from many problems including hyperactivity, impulsivity and inattention as well as problems in social relationships. Although medicine alleviates many ADHD symptoms, it rarely solves the social relationship problems. We experimentally and clinically studied the effect of drama therapy on improvement of the social relationships in 32 children aged 7 to 11 with ADHD. Children were classified randomly into control and experimental groups. The experimental group received two 75 minutes intervention of drama therapy sessions per week and the treatment process continued for six weeks. We used Social Skills Rating System of Gresham-Elliott (SSRS) to assess social skills for both pre/post treatment evaluations. The results illustrates that there are significant differences in improvement of the social skill between control and experimental groups. The significant difference were seen for all subscales of social skill including assertiveness, cooperation, and self-control as well as for total score of social skill. A three-month follow up assessment replicated the findings. Our study suggest that dram therapy can be used along with other current and medical intervention to improve the social relationships of children with ADHD.

The picture superiority in free recall: The effects of semantic association and age

Christiane Baadte & Bozana Meinhardt-Injac

Johannes Gutenberg University, Mainz

According to the picture superiority effect (PSE), items studied as pictures are better remembered than items studied as words. One explanation is that pictures receive more extensive semantic processing than words, resulting in deeper levels of processing. While the PSE has frequently been demonstrated with regard to single items, only few studies have investigated the PSE in recognition of associated picture-picture items. In the present study, the assumption was tested that in a free recall task the PSE depends on the semantic associations between the picture-picture pairs. In addition, as the PSE seems to follow developmental trajectories, we investigated whether children, younger and older adults show comparable PSE effects with respect to associative recollections. Participants (59 children, 40 younger and 22 older adults) first studied a total of 60 word pairs that were presented in pure lists of either 20 word-word pairs, 20 word-picture pairs or 20 picture-picture pairs. In each list half of the pairs were strongly semantically associated (e.g., house-roof) whereas in the other half they were non-associated (e.g., e.g. pot-bus). After each block, participants were asked to recall and write down as many pairs as possible from the previously studied list. The percentage of correctly recalled pairs was used as the dependent variable. In line with our assumption, a PSE was only found for semantically associated picture-picture pairs. Moreover, the decrease in recall between associated and non-associated picture-picture pairs was greatest for older adults. The results point out to the significance of semantic processing for the PSE in associated

picture-picture pairs.

Dynamics of user experience and trust in websites

Nils Backhaus

Technische Universität Berlin

User experience (UX) and trust are important factors for the user's subjective evaluation of technical systems and their usage behavior. In two laboratory experiments (N1 = 20, N2 = 40) the usability of a web site has been manipulated. The user's subjective experience (emotions and UX) as well as trust over time were assessed. It turned out that the valence dimension of emotional experience changed over time and reflected general assessment processes of the website and the trustworthiness of the website. The dynamic curves of the emotional activation and experience, as well as the bivariate correlations with UX and trust dimensions illustrate the importance of the dynamic assessment of experience in the context of digital systems.

Evaluative conditioning for objectively supraliminal, but subjectively subliminal CSs

Karoline Bading & Christoph Stahl

University of Cologne

Evaluative conditioning (EC) refers to the phenomenon that initially neutral stimuli (CSs) are evaluated more positively (negatively) after repeated co-occurrence with positive (negative) stimuli (USs). EC has been demonstrated to occur both with and without awareness of the CS-US pairing, with operational criterions of awareness varying widely between pertinent studies. One branch of research addresses the issue of "EC without awareness" in terms of an undetected CS-US contingency under clearly supraliminal presentation of both CS and US. In these studies, EC effects occurring without contingency-awareness (if present at all) are typically somewhat smaller than those occurring with contingency-awareness. Another approach to the investigation of "EC without awareness" seeks to obscure the systematic CS-US pairing by presenting CSs for durations at (or below) the threshold for conscious perception. Empirical evidence for such subliminal EC effects suffers from both scarcity as well as insufficient control for fully subliminal presentation of CSs. In a series of studies, combining the aforementioned approach to "subliminal EC" with a rigorous trial-based visibility check, we did not find EC effects for briefly presented and masked CSs. In other words, no EC was found for CSs presented below the objective perceptual threshold (i.e. when CS identification was at chance level). A new study focuses on the possibility that some CSs, while objectively supraliminal (i.e., correctly identified at above-chance level), may remain below a (higher) subjective awareness threshold (i.e., are accompanied by a lack of subjective awareness), and on the issue of whether subjectively unaware EC effects can be found for these stimuli.

The influence of odor on attentional control: Insights from a trial-by-trial modulation

Pamela Baess, Ryan P. Hackländer, Clara Hellweg & Christina Bermeitinger

University of Hildesheim

It has recently been suggested that specific task-irrelevant odors have an effect on the allocation of attention in time (Colzato et al., 2014). The attentional control is modulated depending on the nature of the aromas (arousing vs. calming) presented during the attentional blink paradigm. Arousing aromas were found to yield a larger attention blink. However, it is still unclear what mechanisms are modulating the effect of odors on attentional control. More specifically, one could address the question as to whether the way of presenting the odors matters. Here, one can discriminate between a tonic, continuous presentation and a phasic, transient one. The present study aimed at investigating the effect of phasic presentation of task-irrelevant odors on the attentional blink. We used an attentional blink paradigm with an arousing odor (peppermint) and a calming odor (lavender) similar to the task used in the recent study by Colzato et al. In contrast to their experiment, we applied a trial-by-trial-presentation of the task-irrelevant odors using an olfactometer. Participants were asked to respond to two digits presented in a rapid stream of letter distractors. The task-irrelevant odors modulated the attentional blink effect supporting the idea that odors influence the allocation of attention in time. More precisely, our preliminary results provide evidence for the idea that odors have a transient impact on attentional control.

Facial attractiveness and the cone of gaze

Andreas Baranowski[a], Helmut Leder[b], Evgenia Boyarskaya[a], Tobias M. Schneider[c] & Heiko Hecht[a]

[a] University of Mainz, [b] University of Vienna, [c] University of Bamberg

In this study we show that the perceived cone of gaze of a person is related to their attractiveness. We found that for men and women (n = 40), average looking female faces were associated with wider gaze cones than attractive and unattractive faces, in a within-subjects design. When the data was analysed for attractiveness of the onlookers, the correlation only persisted for subjects that described themselves as average looking. For subjects who rated themselves as very attractive the difference disappeared. These findings partly contradict the previous theory that the width of the gaze cone is correlated with the attractiveness of the stimulus in terms of a linear relationship. As an alternative explanation we posit a comfort zone that is related to a wide gaze cone. This is in line with the matching hypothesis, which proposes that we are most interested in people that are similar to us in real-life interactions.

We call it "DIRTI" (Disgust-RelaTed Images) – Development and validation of a picture set for disgust

Antonia Barke, Julia Glombiewski & Anke Haberkamp

Philipps-Universität Marburg

Aim: Disgust is an unpleasant basic emotion elicited by objects such as rotten food, body excretions etc. It has been implicated in the development and maintenance of psychological disorders such as obsessive compulsive disorder or phobias. A validated picture set to evoke disgust in experimental research is lacking, resulting in researchers' use of unvalidated stimuli from various sources. It was our aim to generate a validated picture set, which contains stimuli of varying degrees of disgust and will be available to researchers as DIsgust RelaTed Images (DIRTI). Method: Freely available pictures in the categories rotten food (FO), animals (AN), wounds/infections (WI), body excretions (EX), lack of hygiene (HY) and death (DE) were selected in a multi-stage process. The final picture set consisted of 300 pictures: 40 pictures in each category and 60 related neutral pictures (N). All pictures were edited to 1024 x 768 pixel (landscape) and picture parameters adjusted to ensure a reasonably even colour tone, contrast and lighting. They were rated by 200 participants (43.6 ± 18.0 years, range 18 - 75; 102 women) with regard to disgust, fear, valence and arousal on 9-point scales from 1 to 9. Results: Category means for disgust (1 = no disgust and 9 = very strong disgust) were: EX 4.4 ± 1.2, (range 1.6 - 6.9); DE 4.5 ± 0.9 (2.3 - 6.2); FO 4.7 ± 0.6 (3.4 - 5.8); AN 3.3 ± 0.6 (2.2 - 4.6); WI 3.7 ± 1.0 (1.8 - 5.5); HY 3.6 ± 1.0 (1.3 - 6.4); and N 1.1 ± 0.1 (1.0-1.4). Age and disgust ratings were unrelated (r = -0.02). Conclusion: For each picture, we supply ratings for men and women. The pictures in each category vary from medium to strong disgust, enabling researchers to choose the appropriate degree of disgust. We hope that the validated stimulus material will prove useful to experimental researchers in the area of disgust and help to improve the comparability between studies.

Assumptions of the process-dissociation procedure are violated in applications to sequence learning

Marius Barth, Christoph Stahl & Hilde Haider

University of Cologne

It is debated whether implicit learning phenomena can be dissociated empirically from explicit learning. In serial reaction time tasks (SRTT), for instance, participants respond faster when the sequence of responses is predictable than when it is random. Research on implicit learning in the SRTT has used the process-dissociation procedure (PDP) to disentangle implicit and explicit knowledge, and results have supported the existence of implicit learning. However, the interpretation of PDP results depends on assumptions that may not be met when applied to the SRTT. We investigated the validity of the PDP when applied to sequence learning. Specifically, we examined the invariance assumptions for both the dominant and the non-dominant process utilizing standard ANOVA and multinomial modeling analyses. In three experiments, participants worked on a SRTT with different types of random or probabilistic materials. Afterwards, explicit

sequence knowledge was manipulated and participants worked on a generation task under inclusion and exclusion instructions. Across all three experiments, we found that invariance was violated to a considerable extent. This violation may lead to erroneous conclusions regarding the respective contributions of implicit and explicit processes to sequence learning. We discuss how tests of the underlying assumptions can be integrated into applications of the PDP to sequence learning.

Comfort inside an aircraft – A mixture of methods

Julia Bastian

Leuphana University of Lueneburg

A mixture of 3 methods is used to experience more about the comfort in an aircraft cabin. In a first inquiry, 10 pictures of aircraft cabin are presented in the combination of pairs in order to find first determinants of comfort with the method of multidimensional scaling. In a second inquiry in interviews students of business psychology are asked about the number of flights, of destinies and airlines. Then nouns and adjectives about the comfort in an aircraft cabin have been associated. Most people answered first “space”, concerning the comfort in an aircraft cabin which is often connected with the term leg room. In a third inquiry, questionnaires are filled out of passengers at Hamburg Airport as a basis of proving hypothesis of the factors of comfort in an aircraft cabin. At Hamburg Airport 301 air travelers filled out questionnaires about their comfort inside aircraft cabins. On a five point scale, they were asked how satisfied they felt from very bad to very well. Using factor component analysis, the 24 items conducted out of the interviews were reduced to 5 dimensions. “Physical factors” are temperature, noise, air quality. Psychological factors are the feeling of safety, the friendliness and competence of the crew. Physiological conditions as the amount and quality of food and drinking are identified in this dimension. And as a last dimension, organizational influences as timeliness and a cost-benefit perspective are part of the questionnaire. Independent factors as the length of the flight, the fear of flying and the comfort of the flight are examined in order to discover the influence of different groups.

Wahl ohne Qual – Der Einfluss von Farben auf die Entscheidungsfindung

Thomas Bäumer, Katrin Beck, Franziska Kolb & Anja Pfeifer

Hochschule für Technik Stuttgart

Jeder Mensch trifft täglich eine Vielzahl von Entscheidungen, häufig ohne lange darüber nachzudenken. Gerade bei spontanen Entscheidungen lassen wir uns dabei von Gefühlen leiten (vgl. Schwarz, 2012 „feeling as information“). Dabei kann unser Gefühl leicht durch situative Reize beeinflusst werden, z.B. mittels Priming. Die vorliegende Studie hatte das Ziel, eine Auswahlentscheidung mittels Farbstimuli unbemerkt in Richtung der dargebotenen Farbe zu beeinflussen. Unter dem Vorwand der Teilnahme an einem Quiz wurden hierzu

Versuchspersonen unauffällig rote (n=47) bzw. blaue (n=50) Farbreize dargeboten. Einer Kontrollgruppe (n=22) wurden keine besonderen Farbreize dargeboten. Zur Belohnung entschieden sich die Versuchspersonen anschließend zwischen roter und blauer Schokolade. Den Farbreizen ausgesetzte Versuchspersonen wählten die vorher dargebotene Farbe deutlich häufiger, ohne sich dessen bewusst zu sein. In der Kontrollgruppe war die Farbpräferenz gleich verteilt. Somit zeigt der Versuch, dass die Voraktivierung eigentlich irrelevanter Eigenschaften eines Produkts, die Produktwahl unbemerkt beeinflussen kann. Eine mögliche Erklärung könnte sein, dass durch die Voraktivierung einer Farbe die visuelle Verarbeitung des Produkts leichter fällt. Die dabei erlebte Verarbeitungsleichtigkeit („processing fluency" – vgl. Reber, Schwarz & Winkielman, 2004) wird als angenehm empfunden und dieses Gefühl auf das bewertete Produkt übertragen. Das funktioniert v.a. bei erfahrbaren Reizen („experiental attributes" - Brakus, Schmitt & Zhang, 2014), wie z.B. der Farbe eines Produkts. Eine alternative Erklärung wäre, dass die Aufmerksamkeit durch das Priming auf gleichfarbige Produkte gelenkt wird und die Probanden sich für das dem Priming entsprechend farbige Produkt entscheiden.

Names of novel tools elicit mu-rhythm suppression over sensory-motor cortices

Laura Bechtold, Marta Ohio & Christian Bellebaum

Heinrich-Heine-Universität Düsseldorf

The conceptual representation of objects is thought to be grounded in those sensory-motor brain areas that were active during the forming of the object's concept in semantic memory. In the last decade, fMRI and ERP studies investigated the role of object-related sensorimotor experience in object representations by focusing on the neural correlates of conceptual knowledge acquisition. Altogether, the results of these studies showed an involvement of sensorimotor areas elicited by the post-training confrontation with trained objects, reflecting the object-related learning experience during acquisition. A still unanswered question is how conceptual information is accessed through novel names of novel objects (i.e. verbally, in the absence of the denoted novel objects). The current event-related de-/synchronisation (ERD/ERS) study investigated, if learned object names also elicit motor cortex activation when associated with novel tool-like objects. Healthy, right-handed subjects learned object names during three training sessions, in which objects were actively manipulated, visually explored or did not appear at all (verbal training). In a subsequent test session, we recorded EEG in response to the object names. The lower mu-rhythm (8-10 Hz) ERD over C3/C4 showed a significant main effect of the training condition after 200 to 400 ms, with the highest mu-rhythm ERD for visually trained object names. This higher ERD could reflect more effective imagery processes for names of objects that were visually explored compared to the actively manipulated and verbally trained object names. The results show that different kinds of experience can form different object concepts after a short training period.

More than just positive or negative: How the interaction between evaluative and semantic relatedness shapes latencies in two sequential priming paradigms

Manuel Becker & Karl Christoph Klauer

Universität Freiburg

The malleability of early semantic encoding processes by evaluative information has been subject to debate for over twenty years (Herring et al., 2013). The issue has been investigated in sequential priming paradigms using the evaluative decision task (EDT) and the Pronunciation Task (PT), among others. In a series of experiments, we have revisited the hypothesis that irrelevant evaluative information can influence subsequent semantic encoding processes, at least if attention is directed towards the evaluative dimension (e.g., Klauer, Becker, & Spruyt, in press). In the course of this project, we observed that both EDT and PT studies vary noticeably on how strongly primes and targets are semantically related (independently of evaluative relatedness, henceforth called "semantic relatedness"). While a host of studies have examined the different facets of evaluative relatedness (see Wentura & Degener, 2010), the interaction between the evaluative and semantic relatedness of prime-target pairs in the EDT has to the best of our knowledge not been formally studied, nor compared with results of the PT. The current experiments were modeled after a study by De Houwer, Hermans, and Spruyt (2001). Participants were shown prime-target pairs that were completely crossed regarding their semantic relatedness (semantically related vs. unrelated) and their evaluative relatedness (evaluatively congruent vs. incongruent). Half of the participants were presented with degraded targets, the other half were presented with undegraded targets. They then had to evaluatively categorize (experiment 1, N=60; EDT) or pronounce the targets (experiment 2, target N=180; PT). The results of these studies inform the debate on the relationship of evaluative and semantic information in memory and should sensitize researchers to be aware of the influence of semantic relatedness on evaluative priming. They may also advance the debate on the existence of evaluative priming effects in the PT.

Look into my eyes! Exploring the effect of addressing in multimedia learning

Maik Beege, Steve Nebel, Sascha Schneider & Günter Daniel Rey

TU Chemnitz

Since the concept of parasocial interaction was defined almost 60 years ago, plenty studies were conducted to investigate how recipients get affected by personae, the fictional or nonfictional characters in multimedia. However, there is a lack of research concerning the connection between parasocial processes and learning performances. This study aims to investigate the influence of addressing in an educational video on learning performance. Videos showing a lecture on statistics in an auditorium were produced prior to the experiment. Addressing was operationalized by manipulating how the lecturer was presented in these videos. The presentation was varied in terms of proximity (near vs. far) and orientation (frontal, eye contact vs. lateral, no eye contact). All videos were filmed simultaneously in order to use the same audio track for all videos. We conducted an experiment with 88 participants who were

randomly assigned to one of the four experimental groups (near frontal vs. near lateral vs. far frontal vs. far lateral). Results revealed a large significant orientation effect for retention performance. Although cognitive load was not reduced, frontal orientation led to increased learning outcomes. Proximity did not influence learning outcomes. Results were interpreted suggesting emotional interest and perceived parasocial interaction. Both variables were increased significantly in the conditions with frontal orientation and high proximity. The findings of this study suggest that learning is fostered when personae in educational learning environments give learners the impression to be addressed directly through eye contact. Therefore, parasocial influences in the context of multimedia learning are promising areas for future research.

Do you like being annoyed? Positive effects of disruptive advertising on consumer preferences

Raoul Bell & Axel Buchner

Heinrich-Heine-University Düsseldorf

Advertisers are trying to get customers to love products, but they often do this by annoying them with unwelcome and disruptive advertisements. Is it psychologically plausible that ads have positive effects on consumer preferences even when they are perceived as being disruptive and annoying? On the one hand, theories of evaluative conditioning and distractor devaluation suggest that disruptive advertising should result in decreased rather than increased preferences. On the other hand, mere exposure has often been found to result in increased liking of previously ignored information. In the present study, we examined the effects of ads that were deliberately designed to be disruptive and annoying. Participants played the popular computer game Tetris and were disrupted by ads that blocked the view of the game. In a subsequent 2-AFC test, participants were shown two brands of chocolates (an advertised one and a new one), and were required to select the one they preferred. They knew that they would receive one of the selected brands at the end of the experiment. Even though the ads were subjectively perceived as annoying, they still had (small) positive effects on consumer preferences. Disruptive advertisement may be undesirable from a consumer perspective, but it can be effective.

Brain oscillatory signatures of voluntary resource allocation in working memory

Barbara Berger, Tamas Minarik & Paul Sauseng

Ludwig-Maximilians-University Munich

Working memory (WM) consists of various cognitive processes and maintains and manipulates information no longer available in the environment. Individual processes are co-ordinated by a central monitoring component ensuring their efficient interaction. This central component is strongly linked to top-down attention processes. On cortical level, frontal-midline theta (FMT, a slow EEG frequency found in prefrontal brain areas) was found to be a prime candidate for

serving as such attention/monitoring component. FMT has been shown to orchestrate local activity as well as distant brain areas in visual WM by synchronising fast oscillations (gamma, 30-80 Hz) in posterior brain areas into specific phases of the FMT cycles. This mechanism has been shown to be sensitive to task demands (the more demanding the task the closer to the excitatory phase of the FMT cycle) and causally linked to behavioural performance. The current study investigates whether this fronto-parietal theta-gamma synchronisation reflects voluntary executive control in WM. We designed a dual-task delayed-match-to-sample EEG experiment where participants retained visuospatial and figural information simultaneously. Most importantly, they were instructed to either prioritise the visuospatial or the figural information in alternating blocks. We found that in brain areas sensitive to visuospatial information gamma activity was locked to the excitatory phase of FMT when participants prioritised visuospatial information. In contrast, when participants prioritised figural information the visuospatial-sensitive areas locked gamma to the inhibitory FMT phase. Our results suggest that FMT-phase acts as a central relay orchestrating distributed neuronal activity according to the subjective importance of task specific information to be retained in WM.

The role of cortical space and inhibition in low-level visual cortex for limiting visual working memory

Johanna Bergmann[a], Erhan Genç[b], Ulrich Pilatus[c], Axel Kohler[d], Wolf Singer[e] & Joel Pearson[a]

[a] University of New South Wales, [b] Ruhr-University Bochum, [c] Goethe-University Frankfurt, [d] University of Osnabrueck, [e] Max Planck Institute for Brain Research

The human brain has enormous processing power, but despite this, working memory storage is severely limited. The question of which neurophysiological factors influence these limitations has led to much debate in the past few years. As models of visual working memory (VWM) have stressed the importance of both cortical space and inhibition for representing mnemonic stimuli, here we looked at how the neuroanatomy and the degree of cortical inhibition in primary visual cortex (V1) shape the strong limitations in VWM. Using an individual differences approach, we find that individuals with a larger V1 tend to have greater VWM storage. In addition, we find that a larger V1 is linked to a higher concentration of the inhibitory neurotransmitter GABA in this area. However, the level of V1 cortical inhibition does not seem to be directly linked to VWM storage. Taken together, our results illustrate how the basic anatomy of low-level visual cortex shapes higher cognitive functioning, acting like a bottleneck to what we can actively hold and manipulate in mind.