PROGRAM

27. - 29.07.2017

FIRST MUNICH SYMPOSIUM ON

VISUAL WORKING MEMORY

CONTENTS

VENUE

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OPENING HOURS

Venue building
07:30-22:00 (Mo-Fr)
08:00-18:00 (Sat)

Supermarkets
07:00-20:00 (Mo-Sat)

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DESIGN

Marian Sauter

WELCOME

GENERAL AND EXPERIMENTAL PSYCHOLOGY LMU

TIME TO DISCUSS VISUAL WORKING MEMORY

Visual working memory (VWM) – the mental work space for the temporary storage and manipulation of visual information – is a central cognitive faculty at the interface between visual perception and goal-directed action. It is pivotal for making sense of the constantly changing stream of information arriving through the visual system: Objects move, our eyes move, our body moves, even the whole world may appear to move (such as on a starting train or merry-go-round). To keep track of agents and things in this rapid flow (to maintain object constancy), it is crucial to maintain and match representations of relevant visual objects across all these changes. But beyond holding visual information passively (a function implied by the term 'memory'), VWM is thought to be a general-purpose visual representation system that is involved in a multitude of cognitive functions that require the (active) processing of currently available visual information for achieving the goals of the task at hand. Given this, over the past decades, VWM has become a core topic in the cognitive (neuro-) sciences, sparking an abundance of theoretical and methodological advances that range from general models of cognition and consciousness to the trial-wise decoding of specific mental contents from neuroimaging data.

In organizing this symposium, we intended to bring together world-leading experts on this topic, who represent different theoretical stances and methodological approaches. Our hope is to create an engaging atmosphere that fosters scientific exchange and discussions across the various viewpoints. We tentatively structured the symposium into three thematic sessions: "Models of VWM" on Thursday, "VWM and Attention" on Friday, and "VWM and Long-Term Memory" on Saturday,

MESSAGE FROM THE ORGANIZERS

but we expect that each of these themes will show up in one form or another in every session. We have allowed plenty of time during and in-between sessions for scientific discussions. A moderated General Discussion at the end of each day is meant to help us wrap up what we have learned and consider in more depth issues that cut across and bring together the contents of the individual talks.

We wish to thank the speakers for doing us the honor of following our invitation; the German Research Foundation (DFG), the Munich Center for NeuroSciences – Brain and Mind (MCN), and LMUexcellent for generous financial support; and, last but not least, all those who contributed behind the scene to making this event possible, especially Birgitt Aßfalg and Gabriella Zopcsak for assisting with the symposium organization and taking care of the attendees' creature comforts, and Marian Sauter for designing the program booklet etc. So, we wish us all an enjoyable meeting, and an exciting and intellectually enriching exchange of ideas!

Heinrich René Liesefeld & Hermann J. Müller

SCHEDULE

		MODELS	ATTENTION	LONG-TERM MEMORY
Time	**Wednesday**	**Thursday**	**Friday**	**Saturday**
09:00			Kia Nobre	Masud Husain
09:30				
10:00		Welcome	Coffee	Coffee
10:30		Nelson Cowan	Stefan Pollmann	David Soto
11:00				
11:30		Coffee	Coffee	Coffee
12:00		Klaus Oberauer	Martin Eimer	General discussion
12:30				
13:00		Lunch	Lunch	Light lunch
13:30				
14:00				
14:30		Tim Brady	Jean-Phillipe Lachaux	
15:00	Tutorial by Ronald van den Berg			
15:30		Coffee	Coffee	
16:00		Ronald van den Berg	General discussion	Excursion: Joint sightseeing in the English Garden
16:30				
17:00		Snacks	Poster session	
17:30		General discussion	Poster session (cont.) / Buffet	
18:00				
18:30				
19:00				
19:30		Symposium dinner		

TALKS OVERVIEW

THURSDAY: MODELS

10:30 Differences between a working memory model and a modelling Framework **NELSON COWAN**
12:00 An interference model of visual working memory **KLAUS OBERAUER**
14:30 Structured representations in visual working memory **TIM BRADY**
16:00 Descriptive and rational models of visual working memory limitation **RONALD VAN DEN BERG**

FRIDAY: ATTENTION

09:00 Attention for working memory **KIA NOBRE**
10:30 Cortical representations of visual search templates **STEFAN POLLMANN**
12:00 The control of object selection processes in perceptual attention and in working memory **MARTIN EIMER**
14:30 Some insights about the neural substrates of visual working Memory derived from human intracranial EEG **JEAN-PHILLIPE LACHAUX**

SATURDAY: LONG-TERM MEMORY

09:00 Visual working memory in hippocampal disorders **MASUD HUSAIN**
10:30 Higher-order memory processes for non-conscious items **DAVID SOTO**

TALK ABSTRACTS

Tim Brady

Structured representations in visual working memory

In this talk I'll suggest that in order to fully understand working memory capacity, we need a new theoretical framework that moves beyond counting how many individual items can be stored. In particular, I'll argue that our memory representations are complex and structured even for simple visual displays. In addition to encoding specific items, we make use of our prior knowledge about what objects tend to go together; we encode texture, surfaces and other ensemble statistics; and we make use of the relationships between objects. I'll present an expanded model of working memory incorporating these structured memory representations, and argue that models of working memory need to be capable of dealing with these phenomena in order to provide insight into the structure of the working memory system.

Nelson Cowan

Differences between a working memory model and a modelling Framework

In 1988, I published a Psychological Bulletin article that was intended to summarize what I thought we knew about the information processing system, with an emphasis on the relation between attention, working memory, and long-term memory. Within this article was what I would characterize as a modelling framework: a structure that was far from complete, but that organized the parts of the system as I understood them and made room for subsequent inquiry. Many researchers have used the framework, but have called it a model. I will explore how I came to construct the modelling framework, how it has progressed and changed in the years since it was first published, and what the differences are between a model and a modelling framework, including complementary strengths and weaknesses that they have. Researchers have derived predictions from the framework beyond those that I anticipated at the time.

Martin Eimer

The control of object selection processes in perceptual attention and in working memory

Attention and working memory (WM) are closely linked, and these links are bidirectional. On the one hand, attentional object selection processes are guided by target templates that are assumed to be stored in WM (WM controls attention). On the other hand, the selective maintenance of objects in WM depends on attention (attention controls WM). In this talk, I will discuss both types of links. First, I will present recent results from event-related brain potential (ERP) studies that investigated the content and capacity of attentional templates, and the time course of template activation during the preparation for attentional selection tasks. In the second part, I will focus on the attentional control of WM. I will discuss recent studies using ERP markers of WM activation in unimodal visual or tactile WM tasks and in bimodal visual/tactile tasks. These studies show that these activation states reflect the current focus of spatial attention, and that attentional control mechanisms in WM operate independently for different sensory modalities, with no evidence that storage capacity limitations are shared across modalities.

Jean-Philippe Lachaux

Some insights about the neural substrates of visual working memory derived from human intracranial EEG

In this talk, I will discuss recent suggestions that maintenance of items into visual working memory does not involve sustained High-Frequency Activity [HFA, between 50 Hz and 150 Hz]. I will show very clear examples from intracranial EEG recordings in Humans showing that HFA is in some instances continously elevated during visual working memory maintenance. especially when items need to be maintained in a vivid form (visual imagery). I will elaborate on those examples to propose a putative mechanism for visual working memory maintenance which main merit is to remind and summarize several mechanistic constraints apparent in intracranial EEG signals.

Klaus Oberauer

An interference model of visual working memory

Popular models of visual working memory assume that working memory is limited by a constant resource, which is conceived as either quantized (as in slot models) or infinitely divisible. These models share the assumption that the probability and quality of retrieval depends on the resource assigned to a representation in working memory. We present an alternative model that incorporates the principles of general theories of memory: Retrieval is cue-based, and performance is limited by interference arising from several sources. Items compete for retrieval according to the amount of evidence from memory in favor of each item. Evidence arises from three sources: Persistent activation of item representations, activation from cueing at retrieval, and background noise. One item is held in the focus of attention; this item is represented with higher precision, and suffers less interference from competing items. So far the model explains set-size effects as well as pre- and retro-cue effects in the continuous-reproduction paradigm. We are currently extending the model to recognition/change detection; depending on how much progress we make until July we will present some of that work as well.

Masud Husain

Visual working memory in hippocampal disorders

The mechanisms underlying rapid forgetting are extremely controversial. New methods to measure the precision of visual short-term and working memory using continuous responses (rather than binary yes/no reports) provide a sensitive probe. Here we first use these techniques to examine rapid forgetting in healthy people and show that both temporal decay and interference modulate recall. Then we apply these methods to four different patient groups to reveal different signatures of deficit.

We show that individuals with focal medial temporal lobe (MTL) lesions and familial Alzheimer's disease – both of whom have hippocampal damage – demonstrate increased misbinding of object features held in memory. Their memories are corrupted by interference from other items held in short-term memory. By contrast, a different population of patients – those with Parkinson's disease (PD) and a group at high risk of developing PD – show increased vulnerability to random corruption of memories. Using these methods we also examine how visual items are affected when memories have to be updated or protected from distracting information.

The findings show that although different patient groups have working memory deficits, there may be different underlying mechanisms that can be revealed using behavioural methods. Moreover, they suggest that the hippocampus plays a specific role in short-term memory by binding object features, a process that may be analogous to its role in relational binding in episodic memory over longer time scales.

Kia Nobre

Attention for working memory

Our perceptual experience brokers between previous experience and future events. Working memory sits right at the critical interface, maintaining representations for prospective goals. In my talk I will consider how attention supports working memory, by dynamically prioritising and selecting items for encoding, during maintenance, and for retrieval.

Stefan Pollmann

Cortical representations of visual search templates

When we search for an item, we may form a template that restricts attentive processing to a set of relevant target-defining features. Visual search involves a large network of fronto-parietal cortex. Traditionally, one might think that the more posterior areas represent the stimulus features, whereas the more anterior areas serve as control centers.

However, when we analyzed the information content of fMRI activation patterns in a cued search task, we found that large parts of the frontoparietal attention network, including the frontal eye fields and lateral prefrontal cortex, changed stimulus representation depending on which stimulus dimension (orientation or spatial frequency) was cued as relevant for the upcoming search. Specifically, relevant features were represented more similar to each other and more dissimilar from irrelevant features. More generally, both frontal and posterior stimulus representations were altered depending on task demands. In addition, during cue presentation, the sensory features of the cue could be decoded in occipital cortex, but also in frontopolar cortex, an area involved in adaptive stimulus-driven attentional reorienting.

Search templates may be positive, indicating target features, or negative, indicating distractor features. We found that negative templates were associated with less activation than neutral or positive templates in occipital and parietal cortex, indicating that negative templates may elicit a withdrawal of attentional resources from early visual processing.

David Soto

Higher-order memory processes for non-conscious items

In this talk, I will present a series of studies suggesting that higher-order mnemonic functions e.g. working memory and recognition memory, are not necessarily linked to states of conscious visual awareness. Non-conscious visual items can be maintained 'online' for several seconds, and be later retrieved to guide memory-based decision making and influence metacognitive confidence. Large-scale parietofrontal areas can support the maintenance of non-conscious memoranda and hippocampal activity can mediate the recognition of non-conscious events as part of a network involving the early visual cortex. These studies challenge the long-held theoretical linkage between higher-order mnemonic functions and conscious awareness and have implications for episodic models of recognition and for existing accounts of consciousness such as recurrence theory or the global neuronal workspace model.

Ronald van den Berg

Descriptive and rational models of visual working memory limitations

The precision with which items are encoded in visual working memory and attention declines with set size. This set size effect fundamentally limits our cognitive abilities and has been modeled using a range of conceptually different ideas, such as the notions of slots, flexible resources, binding errors, and variable precision.

In the first part of this talk, I will present results from a model comparison in which we factorially mixed and matched these ideas, resulting in a model space consisting of 32 models. Fitting these descriptive models to data from 10 delayed-estimation experiments, we found that novel "hybrids" that combine some of the previously proposed ideas account better for the data than any of the original models.

The second part of the talk focuses on the question why set size effects exist in the first place. The standard explanation is that the brain allocates a fixed total amount of resources (e.g., slots or spikes) for stimulus encoding. I will argue that this explanation lacks a rational justification and present an alternative hypothesis based on an ecological notion of rationality: set size effects are the result of near-optimally trading off behavioral performance against neural costs. I will show that models derived from this hypothesis account for set size effects in four different visual working memory and attention tasks.

MUNICH SYMPOSIUM ON VISUAL WORKING MEMORY

Anna Barth & Daniel Schneider

How retro-cues can protect multiple working memory contents from perceptual interference: an EEG study

Selective attention within working memory (induced by retro-active cuing) can serve to protect behavior-relevant information from interference. However, neither the neural correlates of protection from interference nor the amount of information that can be protected by selective attention are well understood. We addressed this issue by running EEG during a visual working memory task based on retro-cues. Participants had to memorize the angle of three differently colored bars followed by one of four retro-cue types either changing the focus of attention in working memory (one-item, two-items) or not (three-items, neutral). Subsequently, a distractor display was presented during the retention interval in half of the experimental blocks. A distractor-induced performance decrease was only observed in three- item and neutral retro-cue trials whereas the presentation of selective retro-cues attenuated the distractor effects. The reduction of activated WM resources following selective retro-cues was reflected by a negative slow wave modulation over parietal midline electrodes. In addition, a P3-like component following the distractor in both high load conditions indicated interference with the information held in working memory. This leads to the conclusion that selective retro-cues lead to a release of cognitive resources for preventing visual distractors from getting access to working memory. Although there was a protection from distraction even in the two-item condition, focusing on a single item revealed the most robust retro-cue benefits. The mechanism lying behind these effects were identified by clustering independent components based on the neural signal. Interestingly, one cluster indicated a suppression of mu-activity in the sensori-motor cortex contralateral to response site only in the one-item condition. As this effect was initiated directly following the retro-cue, behavioral benefits for single items might further depend on a head-start of response planning prior to the processing of the memory probe.

Anna Lena Biel, Tamas Minarik, Barbara Berger, Paul Sauseng

Phase coupling between posterior EEG theta and gamma as a signature of predictive coding

Our visual perception is strongly influenced by our expectancies about incoming sensory information. It is assumed that mental templates of expected sensory input are created that are compared to actual sensory input, which can be matching or not. In cases where such mental templates have to be held in short-term memory, such as in visual attention or search tasks, cross-frequency synchronization between theta and gamma band EEG oscillations has been proposed to serve matching processes between prediction and sensation. In this study, we investigated how matching between sensory input and mental templates from working memory is affected by the certainty about which activated template must be matched. In a visual search paradigm, we compared cross-frequency phase coupling for conditions where participants had to keep either one or multiple templates in mind for successful search. We find that memory matching appeared as a transient posterior phase-synchronization between EEG theta and gamma oscillations in an early time window after search display presentation, around 100-150 ms. Our results suggest a stronger transient phase-synchronization of theta and gamma over posterior sites contralateral to target presentation for conditions where one mental template was required than for multiple templates. This is understood in line with previous theoretical accounts, lending promising support for such transient phase coupling between posterior theta and gamma as a neuronal correlate of matching of incoming sensory information with memory contents from working memory.

Rumeysa Gunduz Can, Thomas Schack, Dirk Koester

Movement re-planning interferes with working memory during the maintenance process: neurophysiological evidence

The present study focuses on the neuro-cognitive mechanisms behind manual actions and action flexibility, particularly, on the neurophysiological interactions between working memory processes (encoding, maintenance, retrieval) and grasping movement flexibility in terms of re-planning. Thirty five participants were tested in a working memory (WM)-grasping dual-task paradigm which required performing the verbal and visuospatial version of a WM task being embedded in a grasp-to-place task. To investigate the neuro-cognitive costs of implementing a new movement plan for WM, 30% of the trials required re-planning of the ongoing grasping movement. Therefore, the present study rested on a 2 (WM domain: Verbal and visuospatial) x 2 (Movement planning: Prepared and re-planned) within subject design. The event-related potentials (ERPs) were analyzed separately for encoding, maintenance and retrieval WM processes. The ERP results showed the re-planning effect during the maintenance process. That is, there are different WM-related ERPs in the prepared condition and in the re-planned condition for both domains. There was no interaction for encoding and retrieval processes. Behavioral results also supported to the ERP findings showing a lower memory performance for both WM tasks in the re-planned movement condition compared to the prepared condition. Here, we showed the initial characterization of neurophysiological interactions between cognition (WM processes) and manual action flexibility (grasping movement flexibility). That is, there are process-specific neuro-cognitive costs of grasping re-planning for the maintenance process of both verbal and visuospatial domains. These findings provide an empirical basis for further neurophysiological investigations of cognitive mechanisms of manual action flexibility.

Siyi Chen, Thomas Töllner, Hermann J. Müller, Markus Conci

Object maintenance beyond their visible parts in working memory

Completion of a partially occluded object requires that a representation of the whole is constructed based on the information as provided by the physically specified parts of the stimulus. Such processes of amodal completion rely on the generation and maintenance of a mental image that renders the completed object in visual working memory (VWM). The present study examined this relationship between VWM storage and processes of object completion. We recorded event-related potentials to track VWM maintenance by means of the contralateral delay activity (CDA) during a change detection task in which to-be-memorized composite objects (notched shapes abutting an occluding shape) were primed to induce either a completed object or a non-completed, mosaic representation. The results revealed an effect of completion in VWM despite physically identical visual input: Change detection was more accurate for completed as compared to mosaic representations when observers were required to memorize two objects, and these differences were reduced with four memorized items. At the electrophysiological level, completed (relative to mosaic) objects gave rise to a corresponding increase in CDA amplitudes. These results indicate that, while incorporating the occluded portions of the presented shapes requires mnemonic resources, complete-object representations thus formed in VWM improve change detection performance by providing a more simple, regular shape that can be retained more effectively. Overall, these findings demonstrate that mechanisms of object completion modulate VWM, with the memory load being determined by the structured representation of the memorized stimuli.

Thomas Christophel, Polina Iamshchinina, Chang Yan, Carsten Allefeld, & John-Dylan Haynes

Decoding attended and unattended items in working memory

Working memory enables retention of a limited number of stimuli differently prioritized depending on current goals. In prior work, attended memory items (AMIs) were found to be represented in a form of brain activity patterns which can be decoded using multivariate pattern analysis (MVPA). Unattended memory items (UMIs) that are less relevant during the task, however, could not be decoded even if they could be recalled. These findings lead some to postulate that working memory operates in an activity-silent state using short-term synaptic plasticity. We revisited this question using (a) a much larger sample size, (b) an experimental design cleanly separating AMIs and UMIs and (c) a more comprehensive set of brain regions. In each trial, participants memorized the orientation of two gratings. A first cue indicated that one of them should be used for a first orientation change discrimination task after a delay. Then, a second cue could select either the same or the other orientation for a second task. Such a double-cuing task forces participants to maintain the orientations of both gratings up until the second cue, but directs attention to the cued item (AMI). We used cvMANOVA MVPA to measure the distinctness of brain activity patterns evoked by maintenance of AMIs and UMIs. Consistent with prior work, visual areas (V1-V4) carried information about AMIs, but not UMIs. However, more anterior regions (IPS and FEF) carried information about both AMIs and UMIs. These results demonstrate that UMIs are retained in an active (not an activity-silent) state.

Patrick S. Cooper, Samuel Mclellan-Hall, Montana McKewen & Frini Karayanidis

Amplitude modulation of single-trial midfrontal theta oscillations predict behaviour

Cognitive control processes allow the recruitment of goal-appropriate cortical regions to facilitate effective performance. While a broad frontoparietal network supports cognitive control, the medial prefrontal cortex (mPFC) is thought to play a critical role in control. MPFC likely recruits goal-critical regions through dynamic modulation of low-frequency, theta (4-8 Hz) oscillations. In this study, we explored whether such theta-band modulation supported cognitive control by improving behaviour. That is, could single-trial theta-band dynamics predict single-trial behavioural performance? Sixty-four participants performed a cued-trials task switching paradigm while simultaneous electroencephalography (EEG) was recorded. Critically, our cued-trials paradigm allowed us to explore whether theta dynamics were restricted to either preparatory benefits to performance (i.e., cueing benefits) or target-driven, reactive benefits to performance (i.e., stimulus resolution processes). For each participant, single-trial time-frequency power was extracted from midfrontal electrodes, alongside that trial's reaction time, and entered into a robust regression. This produced regression time-frequency maps for each participant, which were standardised and assessed using parametric statistical analyses. We found a strong locus of midfrontal theta-band activity that predicted RT. Specifically, during the cueing period, enhanced theta power led to faster RT (i.e., better performance) on trials with informative cues. Post-target we also found enhanced theta predictive of faster performance. Further exploration of these results revealed that ongoing theta oscillations were present during all trials (irrespective of performance speed). However, amplitude modulation of these theta oscillations post-cue led to knock on effects during the course of the trial, shifting the latencies of theta amplitudes pre and post-target onset. These amplitude modulations appeared to underpin benefits to performance Together, these results provide novel evidence of trial-by-trial midfrontal theta dynamics that underpin effective cognitive control. Interestingly, both preparatory and target-drive control processes were supported by a common midfrontal theta mechanism.

Gordon Dodwell, Hermann J. Müller, and Thomas Töllner

The influence of acute physical activity on accessing visual working memory

While a growing body of research has investigated the effects of aerobic exercise on cognitive performance, few have attempted to monitor exercise concurrent cognitive processes via EEG, and fewer still have taken an event-related approach. As such, very little is known regarding the influence of aerobic activity on the temporal dynamics of concurrently performed cognitive tasks. The present study aimed to break new ground in this domain by elucidating the influence of both seated and upright modalities of acute aerobic exercise on the temporal dynamics of visual working memory (VWM) performance. 18 participants performed a retro-cue task during sitting (using a recumbent exercise bike) and standing upright conditions (using a treadmill), both being at rest as well as during acute aerobic exercise. EEG analyses focused on event-related lateralizations reflecting three separate phases of the cognitive processing pipeline (CDA, sLRP, & rLRP). Our results revealed significant effects of acute aerobic exercise and body posture on the temporal dynamics of VWM performance. Both behavioural and sLRP latencies were speeded during conditions of exercise and upright posture as compared to conditions of rest and seated posture, respectively. In addition, the onset of the CDA was slower for upright relative to seated posture. This pattern of effects indicates that the access of VWM representations is facilitated when people were sitting still or cycling as compared to standing still or walking, while the times taken for motor response selection were faster when people were actively performing the task (walking or cycling). Overall, these findings have implications for contemporary models of WM that are built exclusively on data sets recorded during stationary seated conditions, in which participants are required to sit still and to avoid any movements.

Julia Föcker, Matin Mortazavi Kashi, Wayne Khoe, Steven A. Hillyard & Daphne Bavelier

Enhanced attentional control in action video game players: An ERP study

Top-down attentional control has been identified as one underlying mechanism supporting improved performance after action video game play. The neural underpinnings of these effects have only recently been studied using fMRI and appear linked to a reduction in the fronto-parietal network activity during task preparation, with a subsequent rebound in the neural activity of this network during target processing (Föcker et al. in preparation). From a computational point of view, an initial down-regulation of activity during task preparation and then an up-regulation of activity during target processing may contribute to a higher signal-to-noise ratio as participants process the target. Accordingly, the BOLD signal in the fronto-parietal network correlated with AVGPs performance: its increased recruitment during target processing predicted better performance. Here we present a spatial-attention cueing paradigm to investigate the timing of these down- and up-regulations in brain signals that appear to predict behavior in AVGPs. A rapid sequence of Gabor patches was presented in the left and right lower visual fields. At the beginning of each sequence, a visual cue indicated participants to attend to the left, right (focused attention), or both visual fields (divided attention). Participants had to respond as accurately and as fast as possible to rarely presented target Gabors which differed in orientation from the more frequently presented standard Gabors. EEG was recorded from 14 AVGPs and 14 NAVGPs, and event-related potentials (ERPs) were analyzed time locked to the visual cue, the presentation of standard Gabor patches and the participants' response after the correct detection of a target Gabor patch. AVGPs were faster especially in the focused attention compared to their non-game playing peers. ERPs to visual cues indicated reduced amplitudes in AVGPs compared to NAVGPs, especially during the time range of the posterior N1 (170ms – 205ms). This effect indicates an early reduction in EEG signal after cue presentation. ERPs to standard Gabors revealed a larger negativity in the anterior N1(125ms – 175ms) in AVGPs compared to NAVGPs, especially during focused attention, as well as a more pronounced positivity during the time range of the anterior P2 (220ms – 270ms) in the contralateral hemisphere as compared to NAVGPs. Both findings point to enhanced attentional modulation in AVGPs. ERPs time locked to the participants's response showed a more pronounced P300 (0ms – 300ms) amplitude in AVGPs compared to NAVGPs. The results

confirm a down-regulation of the ERPs signal during target preparation and an up-regulation during target processing in AVGPs. Importantly, the down regulation appears early after cue presentation, suggesting a dampening of cue processing in AVGPs. In contrast, during target processing, the larger anterior N1, especially during focused attention, as well as the larger anterior P2 may reflect a potentially superior ability to direct and maintain the attentional spotlight accurately on the attended location.

Marleen Haupt, Christian Sorg, Kathrin Finke

Phasic alertness cues modulate visual processing speed in healthy aging

External warning cues without any spatial or feature-based information lead to short-lived changes in preparatory states defined as phasic alertness. While it was shown that young healthy participants have higher visual information uptake rates under conditions of higher phasic alertness, it is not clear whether this holds also true for aging individuals. In our study, a whole report paradigm based on the Theory of Visual Attention (TVA) with auditory warning cues and a jittered continuous SOA spectrum was applied to compare alerting effects on visual attentional capacity parameters in younger and older participants. In line with previous studies using visual alerting cues, we found an overall increase of visual processing speed in cued compared to uncued trials. The cue-induced processing speed enhancement was equally pronounced in younger and older participants, indicating that alertness effects on visual processing are preserved in healthy aging. This implicates that even though aging is associated with a general slowing of visual processing speed, specific attentional functions such as phasic alertness benefits are spared. These findings are in line with aging research reporting a preserved ability to allocate attention to moments in time.

Kerstin Jost, Atsushi Kikumoto, Tina Schwarzkopp, & Ulrich Mayr

Age-related differences in visual working memory: the role of the consistency of attentional control

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

Patrick H. Khader, Satu Palva, Janine M. Fischer, Frank Rösler, & Julia A. Ewerdwalbesloh

Frontoparietal EEG phase coupling reflects the maintenance and successful memory encoding of constructed objects in visual working memory

How are mental images that have been constructed from their constituting elements maintained as a coherent representation in visual working memory (vWM)? Participants maintained visual objects that they either had to construct from single features or that were presented to them as complete objects. Increased fronto-parietal-occipital EEG phase coupling was found during the

maintenance of constructed objects in the theta, alpha, and gamma frequency bands. A similar pattern was found for an increase in vWM load (2 vs. 4 features) for non-constructed objects. Under increased construction load (2 vs. 4 features for constructed objects), the pattern was restricted to fronto-parietal couplings, suggesting that the fronto-parietal attention network is coping with the higher attentional demands involved in maintaining constructed images, but without increasing the communication with the occipital visual buffer in which the visual representations are assumed to be stored. In a subsequent study, we investigated whether fronto-parietal phase coupling during maintenance promotes encoding into more permanent memory traces. Overall, the maintenance of later remembered in comparison to non-remembered objects was associated with increased fronto-parietal coupling across frequency bands. Importantly, for alpha and beta, this effect dissociated topographically for constructed vs. non-constructed objects, suggesting specific contributions to encoding depending on the kind of elaborative processing in vWM. We conclude from these findings that fronto-parietal phase coupling could be a neural implementation of an attentional control process the serves to keep object elements together as a coherent vWM representation, and, in so doing, promotes memory encoding of these representations.

Laura-Isabelle Klatt, Stephan Getzmann, Edmund Wascher & Daniel Schneider

Sound localization versus detection within auditory working memory and perception: evidence from lateralized alpha oscillations

Previous studies have shown that we can selectively attend to representations held in working memory (WM). Using an auditory search paradigm, we compared the neural mechanisms of selective spatial attention when searching for a target stimulus within either a perceptual array or within WM representations (retroactive search). For both search types, participants completed two separate task blocks, indicating either the localization or the presence versus absence (detection task) of the target stimulus. We investigated modulations of induced oscillatory power in the alpha band (8-13Hz) over parieto-occipital sites (PO7/8) following the presentation of the target sound for retroactive search trials or following the search array for perceptual search trials. Results revealed a highly similar pattern for both search types: While there was a clear-cut lateralized alpha suppression for localization trials, there was no such asymmetry for detection trials. We thus conclude that during perceptual and retroactive search, sound localization (and not detection) is based on on a spatial template stored within a supramodal 'master map' of locations. The findings corroborate results from the visual domain that suggest a substantial overlap in the neural mechanisms of attentional selection in perception and working memory. Further, results add to a growing body of evidence favoring a supramodal attention mechanism. Notably, the results do also point towards critical differences in modulations of alpha power between sound localization and detection.

Christof Kuhbandner, Elizabeth A. Rosas-Corona, Philipp Spachtholz

Evidence for high-fidelity long-term memory representations for shortly presented, unattended, and incidentally encoded visual objects

Research has shown that humans are able to successfully remember details about thousands of visual objects after only a single viewing. The aim of the present study was to probe the limits of this ability. Participants were shown a rapid stream of overlapping object pictures and words, and they were instructed to attend to the words and to press a button every time a word was repeated. A surprise memory test for the objects followed (two-alternative-forced choice test) where one previously seen picture and one new foil picture were shown. Half of the pictures was tested immediately after presentation, the other half 24 hours later. Results revealed that the participants' object memory performance was substantially above chance, even when the objects in the two-alternative-forced-choice test differed only in subtle visual details, even when tested 24 hours later, and even

although participants reported that they do not have any memories. These findings suggest that we store much more about events than previously assumed.

Sandra V. Loosli, Tobias Bormann, Irina Mader, Markus Martin, Cornelius Weiller, Christoph P. Kaller

Resolution of proactive interference in working memory: a single-case study in a patient with bilateral frontal lesions

Introduction: Inferior frontal gyrus (IFG) is often related to proactive interference (PI) in working memory (WM), but also to functions of behavioral inhibition (BI). In this single-case study, we tested these functional associations in a 67-year-old stroke patient with bilateral lesions in the inferior frontal gyrus (IFG) and the anterior insular cortex by using a set of different tasks related to WM, PI and BI. Method: WM performance was assessed with a visual recent-probes task, a visually presented letter n-back task, and a counting span task. Inhibition-related functions were assessed with measures of proactive interference (PI) in the WM tasks, and with two tests of behavioral inhibition (Stroop task, verb generation). Results of the patient were compared to age-matched healthy control groups. Results: Compared to the healthy controls, the patient showed no deficits in the three WM tasks and only marginally increased PI effects. However, a classical dissociation between PI resolution and BI was found, as large BI deficits were evident in the patient compared to the matched controls. Conclusion: Our findings support the relevance of the bilateral IFG and anterior insula in inhibiting irrelevant information, but only regarding BI, and not concerning PI resolution. These findings are in contrast with previous imaging and patient studies emphasizing the crucial role of IFG for PI resolution in WM. Further, bilateral lesions in the IFG and insula appear not to affect WM capacity.

Heinrich René Liesefeld, Anna Marie Liesefeld, & Hermann J. Müller

Controlling access to visual working memory: the prefrontal bias signal

As the capacity of visual working memory (VWM) is heavily restricted, executive control mechanisms that decide which information is allowed to enter VWM are pivotal. Liesefeld et al. (2014) identified a neuronal correlate of such a control mechanism that predicts the amount of unnecessarily stored information and the capacity of VWM. This signal manifests as a negative increase in activity for distractor-present relative to distractor-absent trials over (pre-)frontal EEG electrodes in the event-related potential locked to the onset of the VWM memory display. Re-analyses of our data pattern showed that it might be the power of this control mechanism that directly determines VWM capacity, rather than influencing capacity (only) via reducing the amount of unnecessarily stored information (Emrich & Busseri, 2015). In this ongoing project, we aim to elucidate the nature of the control mechanism. In particular, we ask which information the mechanism reacts to, by trial-wise providing partial information about the memory display prior to its onset. Using this approach, we test whether the prefrontal bias signal is influenced by advance information on the mere presence vs. absence of distractors (Exp. 1), or whether more specific information about the location of targets and distractors is necessary (Exp. 2). It turns out that mere information on distractor presence has no influence whatsoever, but that the prefrontal control signal is expedited by location information. This indicates that the control mechanism reflected by this signal does not induce a general distractor-filtering mode, but rather a bias in the spatial allocation of memory resources.

Christine Mertes, Edmund Wascher & Daniel Schneider

Compliance instead of flexibility. Age-related differences in cognitive control during visual search. Evidence from a spatial cuing paradigm and event-related potentials.

In order to guarantee a flexible adaptation to current behavioral goals, cognitive control mechanisms provide the selection of relevant visual information such as the recovery from attentional capture by distracting objects. By means of event-related

potentials (ERPs) we investigated the effect of healthy aging on cognitive control of irrelevant information. Participants preformed a spatial cuing task where an irrelevant, spatially non-predictive color cue was followed by either a contingent (color search) or a non-contingent (shape search) target with different stimulus-onset asynchronies (SOA). On the behavioral level, involuntary attentional orienting to task-set contingent cues occurred independent of age and persisted over the SOAs. This cuing effect was markedly pronounced for elderly people pointing to an age-related "stickiness" of visual processing. ERP analyses revealed that older and younger adults initially selected the irrelevant cue in the contingent condition (i.e. N2pc) and transferred spatial cue information into working memory (i.e. CDA). Only younger adults engaged inhibitory mechanisms to compensate for capture by the irrelevant cue (i.e. Pdearly & Pdlate). In contrast to younger adults, older adults showed no cue-related attentional orienting in the non-contingent condition indicating that they adjusted their strategic approach in order to compensate for the lack of inhibitory mechanisms. However, this strategy could not prevent attentional capture by task-set contingent cues. Thus, contingent involuntary orienting turns out to be older adults' "Achilles' heel" in the context of cognitive control.

Natan Napiorkowski, Hermann Müller, Iris Wiegand, Anders Petersen, Kathrin Finke and Thomas Töllner

Age-dependent differences in visual processing speed and early, spatially selective processing: Insights from N1pc and PCN activations

Visual processing speed, i.e. the total amount of information being processed per second (Duncan et al. 1999) is one of the key components of Bundesen's Theory of Visual Attention (TVA; Bundesen, 1990). Recently, it has been shown that higher versus lower levels of processing speed are associated with the amplitude of the visual N1 (Wiegand et al. 2014). However, it remains an open issue whether processing speed may also influence early, spatially selective processes as indexed by event-related lateralizationsis (ERLs). Thus, the current study aimed at examining (i) whether interindividual differences in processing speed are reflected by ERLs, and (ii) whether the relation between processing speed and ERL waves is modulated by healthy ageing. To quantify processing speed, we employed a TVA-based whole-report task with simultaneous EEG recording. In the ERLs analysis, we focused on N1pc, Ppc, and PCN waves as potential candidates of spatially specific modulations owing to processing speed level. We found that both N1pc and PCN waves indexed interindividual differences in processing speed, and that this relation was also modulated by ageing. In particular, higher relative to lower levels of processing speed gave rise to increased ERL amplitudes. Further, older participants seem to engage more processing resources during an initial orienting of attention phase (as indexed by the N1pc; Wascher and Beste, 2009), whereas younger participants may encode the entire display during this early phase,

Jan Nasemann, Zhuanghua Shi, Hermann J. Müller & Thomas Töllner

Searching for feature singleton targets within and across sensory modalities: new evidence for a "modality-weighting" account

The modality-shift effect (MSE) refers to a speed-up in reaction time (RT) when the target is defined within the same (e.g., visual›visual), as opposed to a different (e.g., tactile›visual), perceptual modality as on the previous trial (Spence, Nicholls, & Driver, 2001). Recently, the anterior N1 event-related potential (ERP) wave has been identified to index the MSE, pointing to a re-adjustment of attentional weight-settings from the old to the new target-defining modality (Töllner, Gramann, Müller, & Eimer, 2009). From this study, however, it remained controversial whether switching between dimensions that belong to different sensory modalities occurs at the same hierarchical level as intra-modality dimension switches. This is equivalent to the question whether modality weighting and dimension weighting involve one-and-the-same limited-capacity resource, or whether each modality has its 'own' resource limitation. To approach this issue, we developed a new cross-modal pop-out search paradigm, which required participants to indicate the location (left versus right) of a visual or tactile feature-singleton target via foot pedals. Behavioural results revealed that modality switches were more costly than intra-modality dimension switches, whereas there was no difference

between intra-dimensional feature changes vs. repetitions. The corresponding event-related changes in spectral power were calculated, averaged over single trials, for alpha, beta, and theta power. Overall, our findings point to a separate modality-specific selection level, providing new evidence in favour of the hierarchical processing architecture suggested by the modality-weighting account.

Qi-Yang Nie, Markus Conci & Xiaowei Ding

Hurting object representations during working memory maintenance with irresistible visual distraction

Object representations in visual working memory (vWM) are likely to reflect both task-relevant and -irrelevant aspects from the immediate environment. This present study investigated how distractors presented at different vWM stages influence mnemonic fidelity of non-spatial object features (e.g., orientation). To this end, we presented distractors at encoding, or during maintenance, or across both in five experiments with a delayed recall task in which observers were required to reproduce the orientation of a target object from visual memory. We observed novel, substantial distraction-related costs during the delay period, but not when items were to be encoded, with costs of distraction (relative to a no-distraction baseline) occurring both in measures of guess rates and mnemonic precision of the target items. More surprisingly, such costs of distraction disappeared when distractors were presented sufficiently longer across encoding and maintenance, suggesting that the null influence of distraction at encoding originates from efficient suppression of to-be-ignored distractors since the onset of a memory array. However, such suppression failed when distractors presented across encoding and maintenance shared the same color with target items. Finally, distraction during maintenance was equally disruptive when distractors shared the target items' locations as compared to a condition that distractors occupied different locations. These results provide the first comprehensive evidence that visual distraction during maintenance is irresistible and particularly harmful to object representations in vWM, indicating dissociable influences of visual distraction at different stages of vWM.

Benjamin Peters, Benjamin Rahm, Stefan Czoschke, Catherine Barnes, Jochen Kaiser, Christoph Bledowski

A sequential whole-report reveals different states in visual working memory

Studies of visual working memory (WM) usually involve the encoding and retention of multiple items, while probing a single item only. Little is therefore known about how well multiple items can be reported from visual WM. Here we asked participants to successively report each of up to eight simultaneously encoded Gabor orientations from WM. We observed that precision varied systematically with report order: It dropped steeply from the first to the second report but decreased only slightly thereafter, suggesting that items were reported from different states in visual WM. Additional experiments showed that this steep drop in precision could not be explained by a retro-cue benefit for the first reported item, the longer retention interval for later reported items, or the visual interference by the first report. Instead, the drop in precision disappeared when participants performed an interfering task that mimicked the executive demands of the report procedure after the retention interval and prior to the first report. The present study provided the hitherto missing initial characterization of sequential reports from visual WM. Taken together, these results suggest that a sequential whole-report reveals qualitatively different states in visual WM that may differ in the degree of dependence on executive functions.

Stefan Pollmann, Reshanne R. Reeder, Ninja Horr and Michael Hanke

Cortical representations of visual search templates

When we search for an item, we may form a template that restricts attentive processing to a set of relevant target-defining features. Visual search involves a large network of fronto-parietal cortex. Traditionally, one might think that the more posterior areas represent the stimulus features, whereas the more anterior areas serve as control centers. However, when we analyzed the information content of fMRI activation patterns in a cued search task, we found that large parts of the frontoparietal attention network, including the frontal eye fields and lateral prefrontal cortex, changed stimulus representation depending on which stimulus dimension (orientation or spatial frequency) was cued as relevant for the upcoming search. Specifically, relevant features were represented more similar to each other and more dissimilar from irrelevant features. More generally, both frontal and posterior stimulus representations were altered depending on task demands. In addition, during cue presentation, the sensory features of the cue could be decoded in occipital cortex, but also in frontopolar cortex, an area involved in adaptive stimulus-driven attentional reorienting. Search templates may be positive, indicating target features, or negative, indicating distractor features. We found that negative templates were associated with less activation than neutral or positive templates in occipital and parietal cortex, indicating that negative templates may elicit a withdrawal of attentional resources from early visual processing.

Dragan Rangelov and Jason B. Mattingley

Maintaining multiple attentional sets decreases the specificity of cognitive control

The information-processing capacity of human cognition has long been debated in cognitive neuroscience. In contrast to the classical view, which postulated severe capacity limitations, recent research has shown that humans can concurrently implement and maintain multiple attentional sets – at least as many as two – at no cost. The precise mechanism enabling such "super-capacity" remains unclear. One explanation is that maintaining multiple attentional sets comes at the expense of decreasing specificity. This hypothesis predicts weaker distractor suppression as more attentional sets are maintained. To test this prediction, we developed a paradigm in which two superimposed patches of moving grey dots were presented for several seconds. Three times per trial the colour saturation of the dots gradually increased and then returned back to grey. While highly saturated, the two patches had different colours, making it possible to discern the motion direction of each patch. Two times per trial, one of the patches transitioned to a target colour. The task was to report the average motion direction of the two target-coloured patches. In different blocks of trials, either a single colour or two different colours served as targets. Consistent with recent studies, analyses of response accuracy showed no differences between the single- and the two-target colour conditions. Analyses of concurrently recorded EEG showed that event-related potentials (ERPs) time-locked to the onset of the coloured-dots epochs were virtually identical for the single and the two-target colour conditions in epochs with a target colour. By contrast, the ERPs in epochs without a target colour were stronger for the two target-colours than the single target condition. These findings suggest that distractor suppression is weaker as more attentional sets are maintained, consistent with the idea that maintaining multiple attention sets comes at the expense of decreasing specificity of cognitive control.

Reshanne R. Reeder, Christian N. L. Olivers, & Stefan Pollmann

Setting up a negative template recruits visual cortex and benefits search performance

A "target template", specifying target features, is thought to benefit visual search performance. Setting up a "negative template", specifying distractor features, should improve distractor inhibition and also benefit target detection. In the current fMRI study, subjects were required to search for a target among distractors enclosed in coloured circles. Before search, one of three colour cues appeared: a positive cue indicating the target will appear in the cued colour, a negative cue indicating only distractors will appear in the cued colour, or a neutral cue indicating that the cued colour will not appear in the search display. fMRI results

revealed down-regulation of neural processing in large parts of visual cortex following negative compared to positive cues. An ROI analysis confirmed task-related attention differences between cue types in early visual cortex. We further found a general attention inhibition mechanism in SPL/precuneus for neutral cues ("task irrelevant") compared to positive and negative cues ("task relevant"). These results suggest a cortical distinction between target templates, negative templates, and task-irrelevant distractor inhibition.

Sander, M.C., Maier, P., Napiórkowski, N Finke, K., Töllner,T., Müller, H.J. & Wiegand, I.

Do neural processes in visual short-term memory change over the life-span? Age-differences in hemispheric asymmetry in contralateral delay activity

The HAROLD model (Cabeza, 2002) states a reduction in functional hemispheric asymmetry in older (OA) compared to younger adults (YA). We assessed age differences in hemispheric lateralization in visual short-term memory (VSTM) in two samples, using the contralateral delay activity (CDA) as a neurophysiological marker of VSTM capacity. The first sample of 22 OA (70-75 years) and 12 YA (20-25 years) performed a VSTM task with visual-spatial content, namely a cued change detection (CCD, Vogel et al., 2004) task with colored squares. We expected YA to show a performance benefit and higher CDA amplitude for stimuli processed in the right hemisphere due to right-hemispheric lateralization of spatial content. According to the HAROLD model, we expected a reduced hemispheric preference in OA, which was confirmed by our behavioral data. The second sample of 30 OA (65-78 years) and 32 YA (20-33 years) performed a VSTM task with verbal content, namely a Theory of Visual Attention (TVA, Bundesen 1990) whole report task with letter stimuli. We expected YA to show a performance benefit and higher CDA amplitude for stimuli processed in the left hemisphere due to a left-hemispheric lateralization of verbal content. Behavioral data showed a general benefit for stimuli processed in the left hemisphere. However, the lateralization effect was stronger in OA than YA. Thus, the behavioral data shows a lateralization of VSTM processes depending on task content as well as age-related changes therein. Analysis of the CDA will shed light on neural correlates of the life-span changes in VSTM lateralization.

Zhuanghua Shi, Xuanlian Zang, Leonardo Assumpcao, Thomas Geyer, Hermann J. Müller

From foreground to background: influences of task neutral context on contextual cueing

Selective attention determines the effectiveness of implicit contextual learning (e.g., Jiang and Leung, 2005). Visual foreground-background segmentation, on the other hand, is a key process in the guidance of attention (Wolfe, 2003). In the present study, we examined the impact of foreground-background segmentation on contextual cueing of visual search in three experiments. A visual search display, consisting of distractor 'L's and a target 'T', was overlaid on a task-neutral cuboid on the same depth plane (Experiment 1), on stereoscopically separated depth planes (Experiment 2), or spread over the entire display on the same depth plane (Experiment 3). Half of the search displays contained repeated target-distractor arrangements, whereas the other half was always newly generated. The task-neutral cuboid was constant during an initial training session, but was either rotated by 90° or entirely removed in the subsequent test sessions. We found that the gains resulting from repeated presentation of display arrangements during training (i.e., contextual-cueing effects) were diminished when the cuboid was changed or removed in Experiment 1, but remained intact in Experiments 2 and 3 when the cuboid was placed in a different depth plane, or when the items were randomly spread over the whole display but not on the edges of the cuboid. These findings suggest that foreground-background segmentation occurs prior to contextual learning, and only objects/arrangements that are grouped as foreground are learned over the course of repeated visual search.

POSTER ABSTRACTS

Philipp Spachtholz, Christof Kuhbandner

There are two routes to visual long-term memory and emotions determine which route is taken

Research has shown that observers store surprisingly highly detailed long-term memory representations of visual objects after only a single viewing. However, the nature of these representations is currently not well understood. In particular, it may be that the nature of such memory representations is not unitary but reflects the operating of two separate memory subsystems: A sensory-based subsystem that stores high-precision feature information and an object-based subsystem that stores visual experiences in the form of structurally coherent objects. Such an assumption is usually difficult to test as overt memory responses reflect the joint output of both systems. Therefore, to disentangle both systems, we (1) manipulated the affective state of observers during initial object perception (negative vs. positive) to introduce systematic variance in the way visual experiences are stored, and (2) measured both electrophysiological activity at encoding (EEG) and later feature memory performance for the objects. Results showed that the nature of stored memory representations qualitatively varied as a function of affective state. Negative affect promoted an independent storage of object features that was driven by preattentional brain activities (feature-based memory representations), whereas positive affect promoted a dependent storage of object features that was driven by attention-based brain activities (object-based memory representations). Taken together, these findings suggest that visual long-term memory is not a unitary phenomenon. Instead, incoming information can flexibly be stored by means of two qualitatively different long-term memory subsystems, based on the requirements of the current situation.

POSTER SESSION OF THE M.SC. PROGRAM NEURO-COGNITIVE PSYCHOLOGY

Linda Betz, Paolo Brambilla, Andrej Ilankovic, Preethi Premkumar, Myung-Sun Kim, Stéphane Raffard, Sophie Bayard, Hikaru Hori, Kyoung-Uk Lee, Seung Jae Lee, Peter Falkai, Nikolaos Koutsouleris, Joseph Kambeitz

Computational modeling of reward-based decision making in patients with schizophrenia: a meta-analysis of the iowa gambling task

Patients with schizophrenia (SZ) have often been reported to exhibit impairments in reward-based decision making. These impairments are potentially linked to disadvantageous decision making in everyday live and poor functional outcome. But results are mixed, and several potential confounds such as age, intelligence level, clinical symptoms or medication make it intricate to assess the robustness of these impairments. Thus, in the present study we conducted a systematic literature search and combined classical meta-analyses of studies comparing the performance of SZ and HC on the Iowa Gambling Task with an individual patient data meta-analysis to examine reward-based decision making in SZ. In n = 30 studies described in 28 publications (n = 1166 SZ, n = 1126 HC), SZ displayed statistically significant suboptimal decisions as indicated by disadvantageous deck choices (d from -0.62 to 0.51) and lower net scores (d from -0.35 to -1.00) with medium to large effect sizes. Meta-analysis of n = 5 studies that reported results from computational modeling approaches showed no differences between SZ and HC. A meta-analysis based on individual patient data from n = 5 studies (n = 303 patients, n = 188 healthy controls) confirmed our results. In conclusion, our findings show the considerable impairment of reward-based decision-making in SZ and possibly emphasize the importance of decision-making processes for successful treatment and functional outcome.

Paul Fisher, Virginia Flanagin

Comparison of normalisation techniques for fMRI preprocessing: SPM, DARTEL, and CAT12

Neurological research, particularly fMRI research, has struggled to develop a concrete preprocessing pipeline with regards to normalisation techniques and their application. This raises questions over the efficiency of techniques used by different departments and organizations. The focus of this paper relates to SPM, DARTEL, and CAT12 normalization techniques and their use within an fMRI preprocessing pipeline. The study incorporated three identical sets of data (20 participants) acquired from a navigation study conducted in 2014. The objective was to perform stages of preprocessing on each version of the data and compare the results in terms of efficiency, optimization, usability, and quality of fMRI normalization. The results demonstrated that CAT12 produced the highest quality of normalization out of the three techniques. However, this was limited by methodological constraints, such as the usage of cropping. One major success of the paper was its employment of a tool for setting the origin point automatically across the data. The key take-home message was that the most effective normalization technique, CAT12, was also the least intuitive and most error-prone technique, with SPM being significantly easier, but with lower quality, and DARTEL being the moderate approach.

Julia Folz, Hermann J. Müller & Thomas Töllner

Relating brain activation to the maintenance of targets in visual working memory: A concurrent ERP-fNIRS-study

Human visual working memory (WM) is highly limited in its storage capacity. This has not only been shown on a behavioural level, but also by means of electroencephalographic brain responses. Vogel and Machizawa (2004), for example, observed a negativity elicited contralateral to the side of currently memorized items during the retention interval of a change detection task. This contralateral delay activity (CDA) was systematically increasing as the number of to-be-memorized items was elevated, reaching an asymptotic level when individuals reached their maximum storage capacity. Accordingly, it has been suggested that the CDA may reflect a process associated with the build-up and maintenance of task-relevant information in visual WM. By concurrently recording brain electrical activity and changes in blood oxygenation via functional near-infrared spectroscopy (fNIRS), we aimed at examining whether varying the number of items in a change detection task may also lead to set size-specific modulations in hemodynamic brain responses. Beyond synchronizing the two methods, a significant correlation would provide a deeper understanding of neurovascular coupling during visual WM maintenance and, hence, the nature of the CDA wave.

Matthew Hollander, Anja Ries, Afra Wohlschläger

Resting state functional connectivity of the ventral tegmental area and dorsal raphe nuclei in major depressive disorder

Major depressive disorder (MDD) is a severe mental disorder increasingly characterized by abnormal network based activity. Resting state functional connectivity (FC) research has illuminated numerous irregularities in the connectivity of MDD patients compared to healthy controls. The present study views resting state FC of the ventral tegmental area (VTA) and the dorsal raphe nuclei (DRN) in 24 MDD patients and 24 healthy controls. The VTA is known to play a large role in the reward system of the brain through a heterogeneous collection of dopamine, GABA, and glutamate neurons. The DRN is integral to serotonergic signaling that contributes to numerous functions such as reward, appetite, emotion, motor function and cognition. Seed based FC analysis showed numerous positive correlations between the present study ROIs and relevant regions found in previous research. Negative FC activity correlations were not found. Differences between FC in MDD and healthy controls were observed, yet future research will further illuminate these differences.

Connor Spiech, Lina Willacker, Paul Taylor

Subjective visual vertical in visual search

Pseudoneglect is a condition where neurologically healthy subjects judge slightly tilted lines as being truly vertical. While many factors have been shown to modulate a person's subjective visual vertical (SVV), the role of spatial attention is still unclear. In our study, we employed a digital version of the classic SVV task as well as a novel task of tilted lines within a visual search array (SVV search task) to investigate the extent that spatial attention affects one's verticality judgments. Our results validate the use of a less researcher-intensive digital SVV task, replicating the general findings within the pseudoneglect literature and suggest that it may be necessary to account for an individual's baseline SVV bias when investigating the role of spatial attention in pseudoneglect.

Ali Ozan Gök, Artyom Zinchenko, Markus Conci, Hermann Müller and Thomas Geyer

Adaptation to change in implicit contextual learning can occur without eye movement

We live in the world of objects that contain spatial regularities. These spatial regularities guide visual attention and facilitate visual search (contextual cueing). Previous work (Higuchi & Saiki, 2017) has suggested that contextual cueing can occur without eye movement. However, the role of eye movements in the context adaptation is not clear. To address this question, we investigated the context adaptation after a change in the target location (relocation phase) under the restricted eye movements. In contrast to the previous work (Zellin, Mühlenen, Müller, & Conci, 2014), participants showed rapid context adaptation effect at earlier blocks of relocation phase. We also observed that contextual cueing effect become larger when the target distance is increasing relative the center point. Overall, results indicate that adapting to the change in implicit contextual learning is independent of eye movements.

Lisa Kröll, Hermann J. Müller & Thomas Geyer

Contextual cueing from explicit and implicit search representations: evidence for one-system accounts of memory

Contextual cueing is characterized by reaction time gains for repeated search configurations in the absence of explicit recognition. This dissociation can be explained by two- or one-system accounts of memory: two-system accounts suggest distinct implicit and explicit storage components, driving search and recognition, respectively. One-system accounts propose a unitary memory resource and attribute non-significant recognition results to a lack of statistical power or independent sources of noise affecting search and recognition measures. To distinguish between two- and one-system accounts, we introduced a learning condition in which participants deliberately memorized a set of 'explicit' displays prior to search. During search, explicit displays appeared along with repeated, yet not previously studied ('implicit') and new (baseline) displays. The results match predictions from one-system accounts: reaction times were fastest for explicit, intermediate for implicit, and slowest for new displays. Recognition performances mirrored this pattern. Eye tracking measures revealed that reaction time gains for explicit displays were accompanied by a shortening of the ineffective and effective search phase, while implicit displays involved an exclusive reduction of the ineffective phase. Furthermore, a subgroup of participants showed evidence of competitive processing resulting in slower reaction times (and a lengthening of the ineffective phase) for implicit relative to both explicit and new displays. We therefore suggest that contextual cueing relies on a one-memory system supporting the search and recognition task alike. The inhibition of implicit displays, however, suggests a functional dissociation of cueing memory into explicit and implicit representations. This reflects an effective memory system representing certain information with high accuracy (explicit displays), while ignoring, or suppressing, concurrent information (implicit displays).

Abigail Licata, Jakob Kaiser, Simone Schütz-Bosbach

Three, two, one, switch! The role of inhibition in sensory attenuation remains opaque

Sensory attenuation occurs when individuals produce actions that lead to a sensory consequence. Individuals tend to judge self-produced sensory consequences as being weaker than consequences generated externally. This attenuation may underlie the distinction between self and other. A behavioral paradigm was implemented in which participants decided and prepared to either make an action or not; randomized externally generated inhibitory signals were implemented to modulate sense of agency in the participants' initial decisions. There were four possible conditions regarding the independent variables of congruency and motor outcome. Individuals' initial decision could either match (intended) or mismatch (unintended) with the trial outcome dependent on the presence of the inhibition signal. The motor outcome of each trial could result in an action or non-action. After decision execution or inhibition, subjective loudness was reported from participants of two tones, an action-contingent tone and a reference tone. Different tones played for action relative to non-action conditions. Electromyography (EMG) of the first dorsal interosseous (FDI) finger muscle was recorded to control muscle activation of action preparation and execution. We postulated that decision inhibition may result in different perception of tone loudness, depending on the influence of congruency and motor outcome on sensory attenuation. There was no difference in loudness perception between levels of congruency and motor outcome variables. EMG results yielded a significantly larger motor activation for incongruent trials relative to congruent trials post "go" signal and an interaction of the independent variables for the preparation stage prior to the "go" signal presentation. The findings support future research in the effect of inhibition in sensory attenuation studies, which may provide a better understanding of this attenuation and its role in self-agency.

Leidy Yurani Cubillos Pinilla, Ondrej Havlicek, Simone Schütz-Bosbach

Spatial action-effect binding in an intentional non-external agent paradigm: a cross modal grouping perspective

An action and its effect are perceived subjectively closer in time. Although own intentions are thought to modulate this time action-effect attraction, it remains unclear how to induce intentions or non-intentions to the actions. Previous studies have shown that time attraction can be transfer to the spatial domain by compressing the distance between an action and its effect. In addition, studies that wanted to see the effect of intentionality in time attraction phenomena, always appeal to external agents to create non-intentional actions. In this study we evaluate spatial attraction in a visual search paradigm in which the subject himself performed intentional and unintentional actions without any external agent interference. By using the eyes, participants had the task to search for a specific shape that was emerged in a various items on the screen. If the participant delays to find the target, a salient distractor shape appeared on the screen. When the participant looked either at target or distractor, the shape disappeared, and as an effect, a yellow dot appear somewhere on the screen and a sound were elicited. Afterwards the participants estimated the distance between the place they were looking and the yellow dot. Thus, eye fixation to the target counted as voluntary, while eye fixation to the distractor was interpreted as involuntary. A small spatial action-effect binding was found in the involuntary condition, but not in the voluntary condition. Furthermore, Eye-tracker fixation data showed a significant underestimation of distance in the involuntary condition related to voluntary condition. The results could be explained by cross modal grouping model, in which more than one sensory modalities in one of the events could segregate both events, resulting in no spatial binding in the voluntary condition. Whereas the small spatial binding in the involuntary condition could be caused by lack of attention to the sensory signals involved in these events. An alternative explanation is that the causal strength, necessary to produce spatial binding, was not enough between the eye fixation and dot probe, as a result of possible poor ecological validity, absence of predictability, and lack of visual information. In order to present a more detailed view of how intentionality affects spatial action-effect binding, further experiments should explore these two alternatives.

Lena Reinholz, Deniz Gursel, Kathrin Koch

Trending towards aberrant intrinsic functional connectivity between the large scale networks in obsessive-compulsive disorder

The impaired performance of patients with obsessive-compulsive disorder (OCD) on a range of cognitive tasks such as inhibition, planning or working memory has been described numerous times. However, whether and which changes in the underlying intrinsic functional connectivity between large scale networks might be accountable for these cognitive impairments remains yet to discover. Aberrant connectivity within a cortico-striato-thalamo-cortical circuitry (CSTC) has previously been associated with performance difficulties in cognitive tasks. Recent research has also linked changes within and between the connectivity of large scale networks such as default mode network (DMN), fronto-parietal network (FPN) and salience network (SN) to OCD. Resting state fMRI data was collected from 25 OCD patients and 23 healthy controls. We aimed to confirm the proposed aberrant connectivity within the CSTC and to contribute to the emerging evidence regarding dysconnectivities of the DMN, FPN and SN. We performed high-model-order independent component analysis (ICA) on the rs-fMRI data, which decomposed the dataset into 75 spatially independent components (IC). Furthermore, the spatial maps (SM) and corresponding time courses (TC) of the networks were extracted from all components. Seven components of interest were selected which reflected the CSTC, DMN, FPN and SN. The intra-connectivity of the spatial maps within the 7 IC's and inter-connectivity of the TC's between components of interest were explored. We could not replicate any significant dysconnectivities with our data set. There was no significant difference between the spatial maps of the 7 components for OCD patients and healthy controls. However, some interesting trends regarding FC between the time courses of the components arose. A Hypo-connectivity between the SN and FPN, between the SN and DMN and within the CSTC, as well as a Hyper-connectivity within the DMN and between the DMN and FPN in OCD patients could be extracted from the data set. These trends seem to support the notion of aberrant functional connectivity in OCD.

Alyssa Torske, Carolina Pletti, Markus Paulus

The influence of moral identity on the neural correlates of moral sensitivity

An individual's moral identity is established when everyday dichotomies of good versus evil and right versus wrong are encountered. In this study, moral identity refers to the extent to which being a moral person is important to an individual's identity or self-concept. Through the use of electroencephalography (EEG) and event-related potentials (ERP), we are able to investigate how individuals who have a strong moral identity, process the observation of morally relevant situations (such as helping vs. hindering). In this study, participant's implicit and explicit moral self-concept were measured and related to ERP components. We therefore are able to offer important insight into the high temporal resolution of how moral identity modulates the perception of morality through early, automatic and later, deliberate mechanisms. Our preliminary results indicate that amplitude modulations can be observed in early, automatic ERP components such as ENP and N1, in addition to later, more controlled ERP components such as N2, and LPP. Further analysis will allow us to observe whether or an individual's moral identity modulates the perception of morally relevant situations through both automatic and controlled mechanisms. Although the current study involves only adult participants, it is important to note that this study is a part of a bigger project that is to include different age groups starting from early childhood.

Erica Westenberg, Doris Schmid, Sarah Gramenz, Thomas Schenk

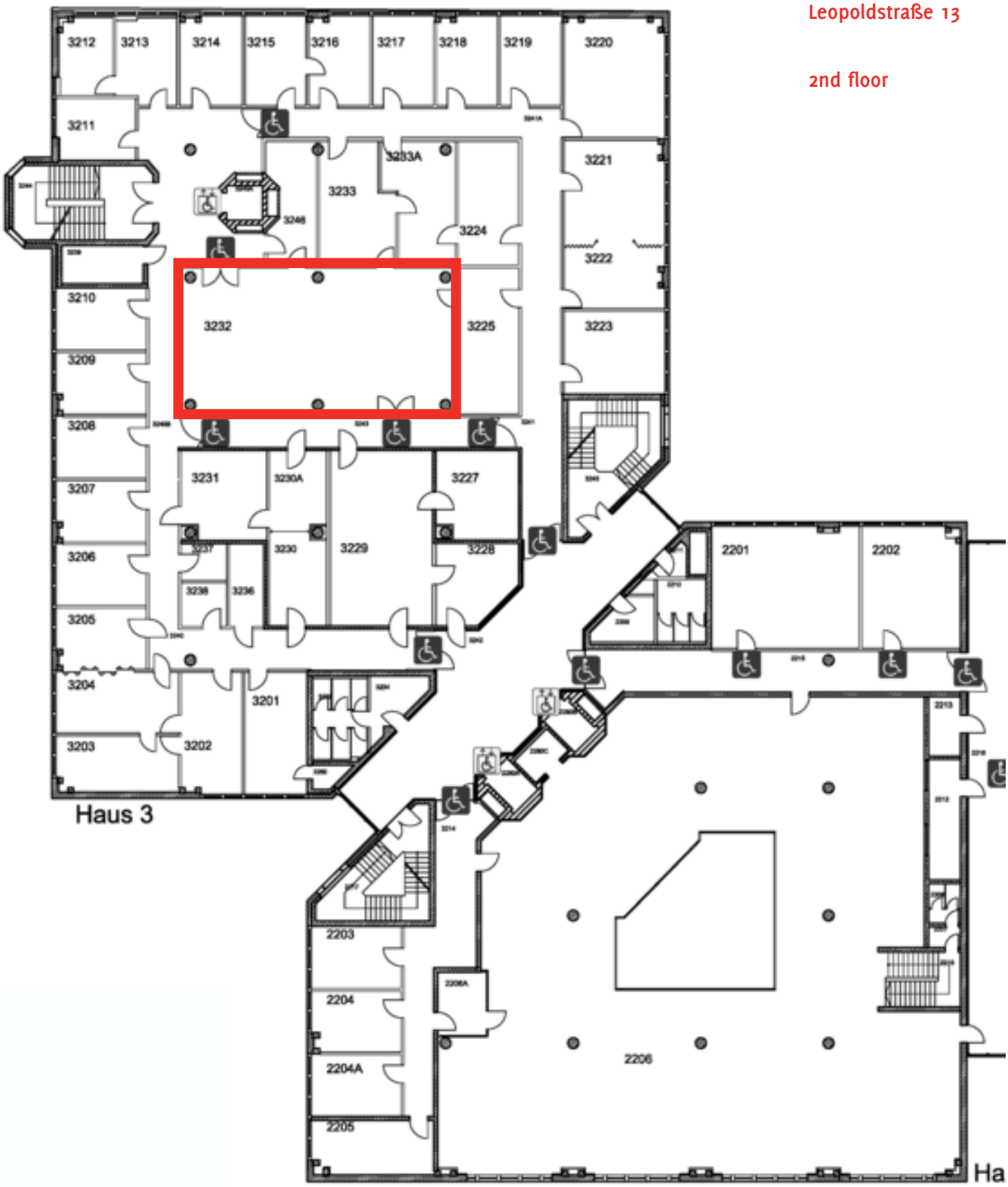
Visual exploration training with virtual reality for hemianopia patients

After a stroke or other brain injury, one of the common impairments patients face is a visual field defect. Most patients who have postchiasmatic lesions along their visual path exhibit homonymous hemianopia, meaning that they are essentially blind in their affected hemifield and thus impaired in many of their activities of daily life. Our goal for this study was to develop and test an effective treatment for these patients. The treatment we focused on was based on evidence that patients with hemianopia have irregular and unsystematic eye movements, which leads to slow and ineffective search strategies. Existing training methods often include computer-based visual search tasks, which teach patients to adopt more efficient exploration strategies and to search their blind hemifield more frequently and effectively. However, these training sessions require patients to regularly travel to their clinics, which can be costly and time-consuming. We therefore adapted existing hemianopia rehabilitation training methods to explore their efficacy within a more mobile training system: virtual reality devices. Virtual reality offers the advantage of creating an interactive, multimodal environment that patients can explore from the comfort of their own homes. Using the Google Daydream virtual reality headset and compatible smartphones, participants were able to undergo daily visual search training independently and train a larger area of their visual field than that which would be trained by a lab computer. We carried out a 2-week-long control study comparing healthy controls with and without daily virtual reality training. At the beginning and end of the 2 weeks, we tested participants on a multiple object tracking task and a visual search task to see whether behavioral and eye-tracking measures would show that subjects who received training had an improved ability to explore their environment in comparison to subjects who did not receive training.

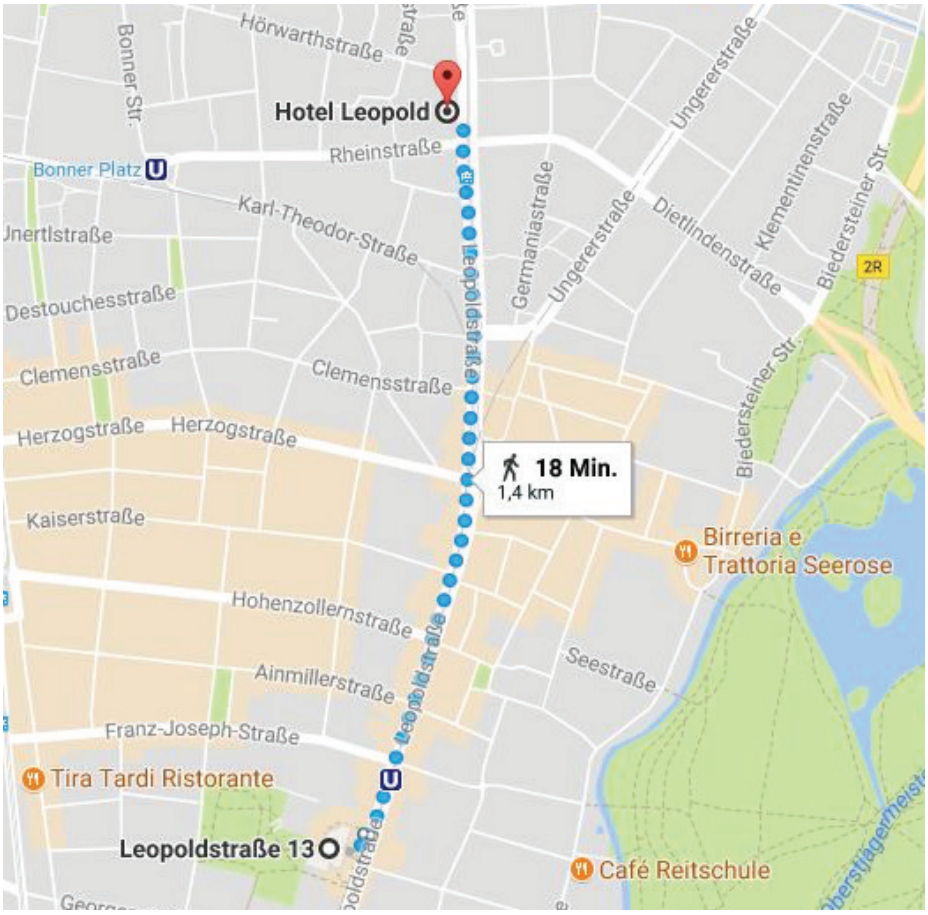
VENUE PLAN

Leopoldstraße 13

2nd floor



AREA PLAN



FROM HOTEL TO VENUE

From the hotel, either walk (18min; see plan on the left) or turn right until the intersection, then turn left and follow Potsdamer Straße until the third intersection. Enter station at the sign and take U6 (direction: Klinkum Großhadern) and get off at 'Giselastraße'. Take the exit at the back of the U-bahn, go up the stairs and turn right.

For public transport, it's best to buy a 3-day-ticket inner district ('Single', 16,50 EUR; 'Group' up to 5, 29,10 EUR). Note that group tickets only print out one ticket, so you have to travel together.

LOCATIONS AND ADDRESSES

CONFERENCE VENUE

Leopoldstraße 13, 80802 München

Get there by: U6 or U3, stop 'Giselastraße'

HOTEL LEOPOLD

www.hotel-leopold.de/en

Leopoldstraße 119, 80804 München

Get there by: U6, stop 'Dietlindenstraße'

JOINT DINNER

Café Reitschule, www.cafe-reitschule.de

Königinstraße 34, 80802 München

Get there by: walking, it's near the venue (see plan)

NEAREST SUPERMARKET

'Tengelmann' @ Leopoldstraße 41, 80802 München

Get there by: walking 5 min along Leopoldstraße

FROM AIRPORT TO CITY

Get an 'Airport-City-Day-Ticket' for 1 person ('Single', 12,80 EUR) or up to 5 ('Group', 23,90 EUR). It's valid until 6am the next day.

TO VENUE

From the airport, take the S S1 or S8 to 'Marienplatz'. Change to the U6 (direction: Garching-Forschungszentrum) or U3 (direction: Moosach) and get off at 'Giselastraße'. Take the exit at the back of the U-bahn, go up the stairs and turn right.

TO HOTEL LEOPOLD

From the airport, take the S S1 or S8 to 'Marienplatz'. Change to the U6 (direction: Garching-Forschungszentrum or Freimann) and get off at 'Dietlindenstraße'. Take the exit at the back of the U-bahn, cross the street and walk along 'Potsdamer Straße' until you reach the third intersection. Directly after the crossing, turn right.

MENSA LUNCH GUIDE

The mensa where we will have lunch on Thursday and Friday is right behind the conference venue. You pay by Legit cards that got handed out at the registration and you can charge them with cash or debit card. There is a selection of different meals available (also vegetarian and vegan options). Some meals are self-serice (pay by weight) and some are portioned (pay by plate). For self-service options, always use the cutlery provided right next to the food you want as prices vary. You can combine main courses and side dishes in any way you like. Below is the prospective meal plan but it is subject to change. You can find the daily menu options being displayed on screen at the entrance of the mensa building (see legend below).

MENU

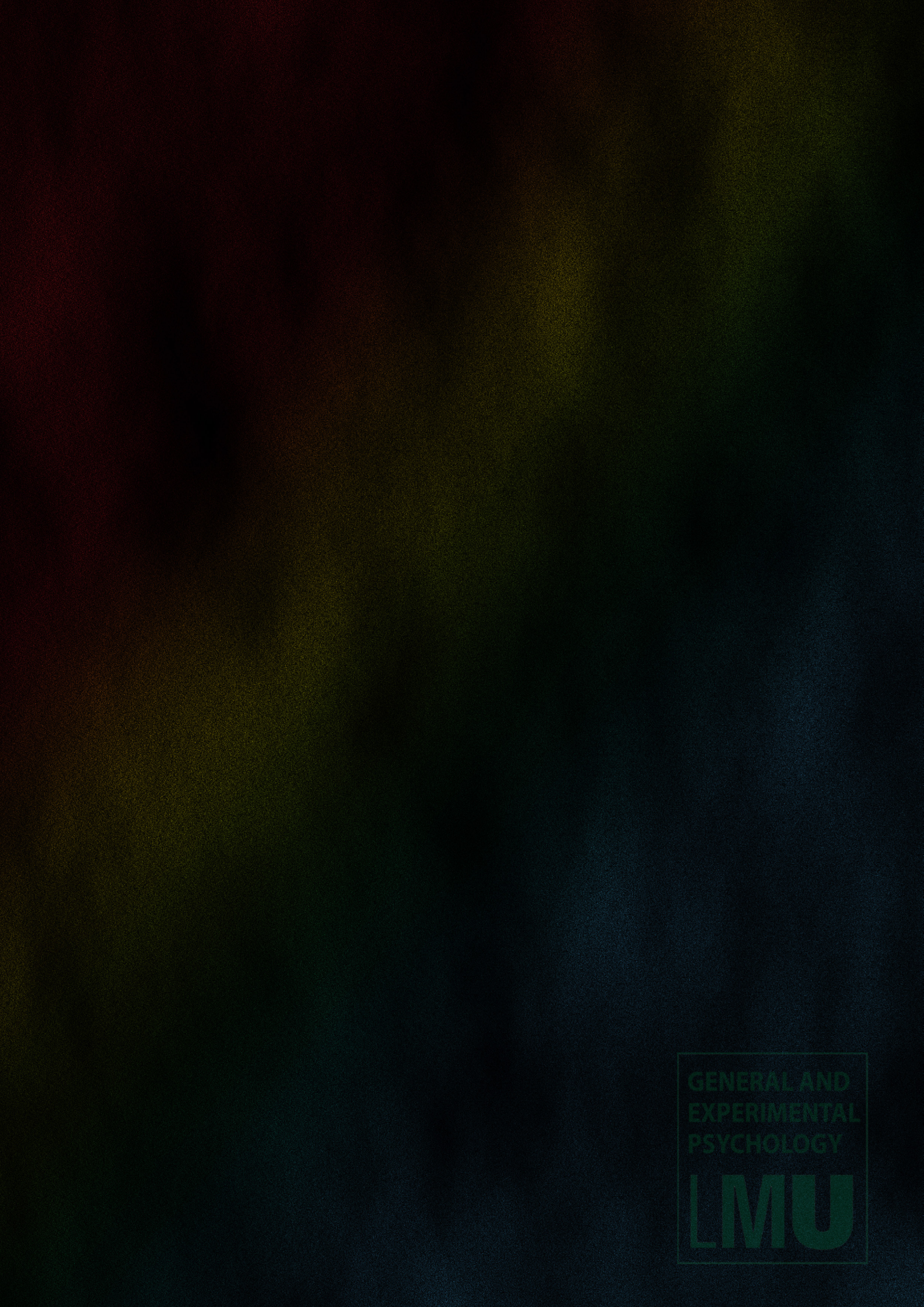
Thursday, 07/27/2017	*weekly overview as PDF*	
Mensa Spezial	Gemüseeintopf mit Ricotta-Spinat-Tortellini [Ei,Gl,GlW,Kn,Mi,Sl]	
	Kartoffeleintopf mit ein Paar Wiener (R,S) (2,3,8) [Sl]	
Mensa Klassiker	Piccata von der Pute mit Salbei und Tomatensauce (2) [Ei,Gl,GlW,Mi]	
Länder-Mensa	Esterhazygulasch vom Rind (BayernOx) [Gl,GlG,GlW,Kn,Mi,Sl]	
Länder-Mensa	Bio-Spätzlepfanne mit Bio-Gemüse [Gl,GlW,Sl]	
Grüne Mensa	Bulgur mit Zucchini und Tomaten [Gl,GlW,Kn]	
Beilagen	Tagessuppe	
	Erbsen-Karotten-Gemüse [Mi]	
	Petersilienkartoffeln (GQB)	
	Reis	
	Tomaten-Penne [Gl,GlW,Kn]	
	Müsli mit gemischten Beeren [Gl,GlH,Mi]	
Aktion	Bulgursalat mit getrockneten Tomaten [Gl,GlW]	
	Süßkartoffel Pommes frites	
	Gemüse Mittelmeer	

Friday, 07/28/2017	*weekly overview as PDF*	
Mensa Klassiker	Kabeljaufilet (MSC) unter der Gurken-Senfkruste [Ei,Fi,Gl,GlW,Mi,Sf]	
Länder-Mensa	Putenschnitzel auf Asia-Pfannengemüse (2) [Gl,GlW,Se,So]	
Länder-Mensa	Germknödel gefüllt mit Pflaumenmus dazu Vanillesauce [Ei,Gl,GlW,Mi]	
Grüne Mensa	Kartoffeleintopf mit Majoran [Sl]	
Beilagen	Tagessuppe	
	Rahmspinat [Gl,GlW,Kn,Mi]	
	Petersilienkartoffeln (GQB)	
	Kräuterreis	
	Nudeln [Gl,GlW]	
	Vanillesahnequark [Mi]	
Aktion	Scharfer Zuckerschotensalat (2) [Kn,So]	

LEGEND

(f)	meatless
(v)	vegan
(R)	beef
(S)	pork

(GQB)	proven quality from Bavaria
(Bio)	organic production (DE-ÖKO-006)
(Bio-Bayern)	Geprüfte Qualität Bio-Bayern
(MSC)	Marine Stewardship Council Standard


GENERAL AND
EXPERIMENTAL
PSYCHOLOGY
LMU