ISCH Action TD0904
Time In MEntaL activitY: theoretical, behavioral, bioimaging and clinical perspectives (TIMELY)

TIMELY Training School on

"Imaging Time"

Otto-von-Guericke-Universität, Magdeburg (Germany), 23-27 September 2013

Organized by

Tömme Noesselt, Argiro Vatakis, Michael Hanke, & Ariel Schönfeld

Information, Programme, Activities, & Abstracts

Location: Leibniz-Institute for Neurobiology, Brennecke-Str. 6 (Medical Campus) Magdeburg, Germany & Otto-von-Guericke-University, Magdeburg, Germany

Travelling by air: Closest airports are Berlin-Tegel (TXL), Berlin-Schönefeld (SXF), Hannover (HAJ) and Leipzig (LEJ). From all airports you can get trains to Magdeburg Central station (1-2 hours, depending on the airport you choose).

For more information on the Training School or joining TIMELY: contact Argiro Vatakis at argiro.vatakis@gmail.com or visit www.timely-cost.eu.

September 23th, 2013

09:30-10:30	Welcome address by the Head of the Neuroimaging Centre Magdeburg
10:30-12:00	Tour of Imaging facilities including 7T-High field MRI, MEG, and SPECT/PET
12:00-14:00	Lunch & Poster presentation
14:00-16:00	*Guided city tour*

September 24th, 2013

09:00-10:30	Talk:"How the brain processes temporal event information - insights from fMRI and PET-studies" Tömme Noesselt
10:30-11:00	*Coffee break*
11:00–12:30	Talk:" Neural oscillations and temporal event structuring in the brain" Virginie van Wassenhove
12:30-13:30	*Lunch break (on your own)*
13:30-15:00	Training session Preprocessing Group 1: fMRI (Tömme Noesselt) Group 2:EEG (Alexandre Gramfort) For advanced students: TMS-approaches (Martin Wiener)
15:00-15:30	*Coffee break*
15:30-17:00	Training session Preprocessing Group 1: EEG Group 2:fMRI
18:00-till late	*Barbecue*

September 25th, 2013

09:00-10:30	Talk:" How the human brain tracks time: a few insights from structural and functional MRI" Domenica Bueti
10:30-11:00	*Coffee break*
11:00-12:30	Talk:" Spatio-temporal correlates of implicit temporal processing - feature-selective attention and attentional control" Ariel Schoenfeld/Christian Stoppel
12:30-13:30	*Lunch break (on your own)*
13:30-15:00	Training session Statistical Analysis Group 1: fMRI (Johannes Tünnerhof) Group 2:EEG (Christian Merkel)
15:00-15:30	*Coffee break*
15:30-17:00	Training session Statistical Analysis Group 1: EEG Group 2:fMRI

September 26th, 2013

09:00-10:30	Talk:" Controlling for sensorimotor and cognitive confounds in fMRI studies of timing" Jennifer Coull
10:30-11:00	*Coffee break*
11:00-12:30	Talk:" Temporal predictions and prediction errors a critical mechanism for multisensory integration" Uta Noppeney

12:30-13:30	*Lunch break (on your own)*
13:30-15:00	Training session Group 1: fMRI – Connectivity Analysis (Johannes Tünnerhof/Uta Noppeney) Group 2:EEG – Wavelets & Source reconstruction (Alexandre Gramfort)
15:00-15:30	*Coffee break*
15:30-17:00	Training session Group 1:EEG – Wavelets & Source reconstruction Group 2: fMRI – Connectivity Analysis
19:30-till late	*Dinner*

September 27th, 2013

09:00-10:30	Talk:" Making the case for natural stimulation: examples for inter-subject alignment and dynamics of visual attention" Michael Hanke
10:30-11:00	*Coffee break*
11:00-12:30	Talk:" Optimal neural networks for human time perception" Martin Wiener
12:30-13:30	*Lunch break (on your own)*
13:30-15:00	Training session Advanced Analyses Group 1: fMRI (Michael Hanke) Group 2:EEG
15:00-15:30	*Coffee break*
15:30-17:00	Training session Advanced Analyses Group 1: EEG Group 2:fMRI

Abstracts

How the brain processes (audiovisual) temporal information - Insights from fMRI and PET-studies

Tömme Noesselt
Department of Psychology, Otto-von-Guericke-Universität Magdeburg, Germany

The temporal structure of events is critical to construct causality and relations across events. Yet the temporal resolution of different modalities differs dramatically. These differences are a major obstacle for the brain to identify crossmodal coincidence.

In my talk I will first present results from numerous experiments on audiovisual and audiotactile temporal coincidence processing using functional imaging techniques. I will also focus on the different research strategies, which have been used to identify coincidence detection in the human brain with functional imaging techniques. I will further highlight potential confounds of those strategies which often neglected cognitive factors, which can significantly influence brain activation patterns. Finally, I will propose a model of the neural networks involved in temporal processing under different task-regimes.

Neural oscillations and temporal event structuring in the brain

Virginie van Wassenhove
INSERM Cognitive Neuroimaging Unit, France

The temporal coincidence of auditory and visual events is a necessary condition for multisensory integration. However, temporal coincidence is defined by the brain, not by veridical simultaneity. For instance, AV speech perception tolerates as much as 200-300 milliseconds of asynchrony between auditory and visual speech inputs; consistent with perception, a temporal window of integration can readily be observed neurophysiologically and considered a marker for predictive coding in the context of AV speech. Beyond temporal coincidence, is temporal coherence across sensory modalities sufficient to enable the construction of a supramodal object in the brain? To address this question, complex AV dynamic patterns were presented to participants while they were recorded with magnetoencephalography (MEG). Participants were trained in a difficult visual coherence discrimination task with or without sounds. We show that temporally coherent AV stimulation drove a supramodal processing mode of cortex and importantly, that AV learning history selectively affects downstream plasticity in areas classically considered to be unisensory (here, visual cortices). These results suggest that in natural environments, the brain exploits temporal correlations for building internal representations irrespective of the sensory modality of inputs. A temporal window of integration implies the loss of temporal information yet our awareness of time and temporal order across sensory modalities can be surprisingly precise. A major question thus emerges: how can integration and segregation occur simultaneously in the brain, for the same informational content? It is here proposed that the encoding and the structuring of events in time capitalize on the natural dynamics of brain processes at an early stage of sensory processing. Specifically, the phase of neural oscillations is proposed to serve an automatic temporal flagging mechanism across sensory modalities while preserving the integrative properties of the system.

How the human brain tracks time: a few insights from structural and functional MRI

Domenica Bueti
Department of Clinical Neurosciences & Functional Electrical Neuroimaging Laboratory, Lausanne University Hospital, Lausanne, Switzerland

Along with space, time is one of the constituent dimensions of our reality. Our ability to effectively respond to dynamic events in our environment is strongly dependent on the accuracy with which we represent their temporal properties. Despite the importance of the temporal dimension for our actions and perceptions, our understanding of the neural mechanisms of temporal computations is far from clear. In my talk I will present a series of high-field (3T and 7T) structural and functional MRI studies in which I have investigated the neural correlates of duration representation and learning. The presented works challenge the idea of a single centralized and amodal 'clock' and support the existence of multiple and distributed temporal mechanisms.

The talk will try to combine the presentation of the scientific content with the introduction of a few methodological issues concerning both functional and structural MRI on timing. Particular emphasis will be given to the statistical modeling of fMRI timing data.

Spatio-temporal correlates of implicit temporal processing - feature-selective attention and attentional control

Christian Stoppel
Klinik für Neurologie, Otto-von-Guericke-Universität, Germany

The allocation of attentional resources involves two interdependent processes: 1.) the upcoming requirements imposed by a given task have to be anticipated to allow for goal-directed behavior. Therein, it is important to understand the mechanisms that mediate the deployment of attentional resources between distinct features, objects and spatial locations. 2.) To allow for goal-directed modulation of the sensory input, attentional resources have to be selectively allocated towards particular features, objects or spatial locations.
Referring to the first process highlighted above, we will investigate how attentional control is neuronally implemented if attention is either shifted voluntarily or involuntarily across objects or locations. We will show that such voluntary or stimulus-driven shifts between objects or locations recruit partially overlapping, but also separable, cortical modules within fronto-parietal, extrastriate visual, and default-mode network regions, implicating the parallel existence of domain-independent and domain-specific reconfiguration signals that initiate attention shifts in dependence of the particular task-demands. Beyond that, we will demonstrate that the neural processes underlying voluntary shifts between objects and locations display partially analogue, but also highly specific spatio-temporal dynamics.
Second, we will investigate how attentional selection of a particular stimulus attribute (i.e. feature-based selection) modulates neural processing of different stimulus attributes. Therein, we will show that feature-based attention i) modulates hemodynamic activity within hMT in a direction-selective manner, ii) operates in a spatially global manner but needs time to spread, and iii) is implemented in a temporally flexible manner depending on the particular physical stimulus characteristics and the respective demands within/of a given task.

Controlling for sensorimotor and cognitive confounds in fMRI studies of timing

Jennifer Coull
Laboratoire des Neurosciences Cognitives, Aix-Marseille University & CNRS, France

A well-designed fMRI study in any cognitive domain should control for processes of non-interest. In the realm of timing, we must consider not only fundamental processes, such as sensory stimulation, motor responding and decision-making, but also some less obvious ones, such as motor preparation, sustained attention and working memory. Using examples from my own work, I'll outline some of the ways in which we have tried to minimize contributions from processes of non-interest, thereby allowing timing-related activations to be interpreted more unambiguously. These procedures include the use of parametric design and analysis; event-related designs and temporal jittering of task components; trial-by-trial randomization of stimulus-response mappings; dynamic cognitive control tasks; and the matching of task difficulty across experimental and control conditions. I will also highlight the utility of correlating brain activity with behavioural performance or stimulus features. This approach not only helps identify which aspect of performance (e.g. accuracy, variability, clock-speed) or stimulus appearance (e.g. duration, size, intensity) correlates with a particular activation, but also provides convincing evidence that this activation reflects the process/feature of interest rather than an incidental, co-occurring process/feature that has not been adequately controlled for.

Temporal predictions and prediction errors a critical mechanism for multisensory integration

Uta Noppeney
Department of Psychology, Computational Neuroscience and Cognitive Robotics Centre, University of Birmingham, UK

Audiovisual synchrony is an important cue informing the brain whether sensory signals originate from a common source and should hence be integrated.

First, we will demonstrate that audiovisual synchrony increases stimulus salience in cluttered dynamic environments via increased connectivity between primary sensory areas. These low level audiovisual synchrony effects enable initial scene segmentation and are gated into higher order association areas depending on task-context.

Second, we will investigate how the brain identifies temporal regularities across the senses. How does the brain respond, when the auditory and visual signals are temporally misaligned, so that the visual signal leads or lags the auditory signal? Our results reveal predictive coding as a mechanism to temporally predict and bind sensory signals into a coherent percept. Audiovisual asynchronous stimuli violating the brain's temporal predictions evoke a prediction error. In line with predictive coding, auditory leading asynchrony elicits a prediction error in visual cortices and visual leading asynchrony in auditory cortices.

Third, we will investigate how sensory-motor experience such as music training tunes these temporal binding mechanisms. Behaviourally, musicians exhibited a narrower temporal integration window than non-musicians for music but not for speech. At the neural level, musicians showed increased audiovisual asynchrony responses and effective connectivity selectively for music in a superior temporal sulcus-premotor-cerebellar circuitry. Our findings show intimate links between action production and audiovisual synchrony perception. Our sensory-motor experience determines whether and how we integrate auditory and visual inputs into a unified percept.

Making the case for natural stimulation: examples for inter-subject alignment and dynamics of visual attention

Michael Hanke
Department of Psychology, Otto-von-Guericke-University, Germany

The human brain has evolved to process high-dimensional, multi-modal and fast changing stimulation. Despite this fact, brain-imaging studies predominantly use highly controlled experiments with simplified or abstract stimulation. Consequently, it is unclear whether important insights have been missed by neglecting the investigation of brain function in more real world-like settings.
More recently, however, with the advent of more powerful data-driven methods an increasing number of studies involve more complex, natural stimulation to investigate cognitive processes -- mostly using movie clips and virtual reality environments (overview in Hugo J. Spiers and Eleanor A. Maguire, 2007, Decoding human brain activity during real-world experiences. TRENDS in Cognitive Sciences, 11, 356-365).

This presentation will show-case two analysis strategies that utilize fMRI data recorded during the presentation of a feature-length action movie: a) functional inter-subject alignment of high-dimensional representational spaces to enable multivariate pattern (MVP) analyses across individuals, and b) investigation of attention deployment by linking similarity of brain activity pattern to spatio-temporal dynamics of eye-gaze.

Our previously developed algorithm 'hyperalignment' (Haxby et al., 2011) is able to build common models of representational spaces within cortical fields by aligning data across brains in a high-dimensional space rather than in an anatomical space. This method is a radical departure from previous methods for aligning functional data across brains that are based on anatomy.
Our results indicate that hyperalignment affords between-subject MVP classification of complex visual stimuli with accuracies that equal or exceed within-subject classification and far exceed between-subject classification of anatomically aligned data. More importantly, our methods capture the organization of representational spaces in terms of a set of basis functions that are topographic patterns associated with distinct response profiles and functional connectivities. This is an important aspect for the analysis of brain activity patterns from natural stimulation, where it is impossible, in contrast to highly controlled experiments, to assign an on/off design to targeted cognitive processes.

Few studies have examined how attention and eye-movement control interact during a complex and rich visual input that simultaneously drives bottom-up as well as top-down attention. By recording eye-gaze for a feature-length movie we were able to confirm highly similar eye movements over the full length of the movie (Dorr at el, 2010, Variability of eye movements when viewing dynamic natural scenes, J. Vis. 10:28). This allowed for establishing a common model of spatial distribution of attention, and coherence across subjects as an indicator for the bottom-up properties of any movie segment. Using a searchlight approach we identified brain areas showing correlated similarity structures of gaze distribution and fMRI activity patterns using representational similarity analysis. We identified a widely distributed network, with a strong right-hemispheric bias, including ventral and dorsal parts of the attention system that is associated with the deployment of spatial attention during movie watching.

We are currently acquiring a multi-subject fMRI dataset at high field strength (7 Tesla) and high resolution (1.4mm voxels) using a 2-hour stimulation with an audio-movie. In order to facilitate the development of methods for the analysis of brain imaging data from natural stimulation, this dataset will be released in the public later this year. An overview of the dataset will be given in this presentation.

Optimal neural networks for human time perception

Martin Wiener
Department of Psychology, George Mason University, Fairfax, VA, USA

Discovering the neural mechanisms for time perception has remained a challenging puzzle in cognitive neuroscience for many years. Despite many neuroimaging studies investigating time perception across a variety of timing tasks, little consensus exists as to which regions are critical. However, despite wide variability in the neural regions activated across time perception tasks, activation within particular networks are actually rather consistent within individual timing tasks. This suggests that each particular timing task activates a specific network that is optimal for the temporal context that task evokes. This talk will delve into the differences in timing task network activation, both between and within individuals, and outline a variety of methodological considerations that should be employed when designing and conducting timing studies.

Student Abstracts

TRIP – A novel method for measuring the timing of a conscious awareness of intention

Ondřej Bečev[1,2], Tomáš Urbánek[3]

[1]Faculty of Medicine, Masaryk University, Brno, Czech Republic, [2]Faculty of Informatics and Statistics, University of Economics, Prague, Czech Republic, [3]Institute of Psychology, Academy of Sciences of the Czech Republic, Brno, Czech Republic

Present poster introduces the proposal of a new method for measuring the timing of conscious experiences.
The current empirical research on free will, sense of agency, awareness of intention and related phenomena in the field of science of consciousness relies heavily on the attempts to objectify the timing of conscious experience. The question of methodological validity of methods widely used receives, however, only a limited attention. Hence, our effort in this thesis aims for (a) providing a systematical review of approaches currently applied, and (b) proposing our original post-hoc measure for timing of conscious experiences, titled "TRIP".
Experiments of Benjamin Libet in early '80s started a boom in neuropsychological research on the question of free will and its particular aspects – notably those related to volitional action, conscious experience of intention and the sense of agency. Majority of these disciplines deploy experiments implementing some form of "measuring" the time of subjective experience. Typically, a moment of "awareness of intention to move" is measured.
A methodological exploration reveals that most of the classical studies use some sort of post-hoc measurement - the judgment about intention to act is done retrospectively, after the action is performed. As a reaction, "online measurement" approach was proposed and first method tested. None of these methods, however, remain without a controversy.
As could be seen in experimental studies, the results obtained depend heavily on a paradigm used, as different approaches presumably measure different aspects of the phenomenon. Still, to our knowledge, this methodological problem stays outside the scope of experimental scientist and almost no serious attempt for a systematical review was done yet.
Aside of the methodological review, a major goal of this text is presenting our original method for measuring the timing of conscious experience. "TRIP" is a post-hoc method based on the projection of letter trigrams, benefiting from phase shift between particular letters of the trigram. This approach allows containing fast-changing and slow-changing elements in parallel and thus providing a flexible measure with multiple scales of different precision running at once. TRIP represents a novel, alternative measure solving some of the criticized features of current paradigms considered as "industry standard". By the date of the TIMELY workshop, first data should be available.

Another point of view: against Hoerl's idea of Present

Sara Coelho

Institute of Molecular Medicine – Faculty of Medicine, Lisbon University, Portugal

What is this thing called Present: is it an instant or is it a time interval? This is an important question to the study of consciousness today, since the sense of time is constructed in the brain. Hoerl argues a version of the Jamesian concept of 'specious present'. The temporal contents of our perceptual experience can't be reduced to a single instant. Acts of apprehension may cover a sucession of events. The temporal contents, however don't give us the concept of time. It is because temporal perception is from a point of view that we can speak of Present. Against Hoerl, I sustain that Present can't be consider a time interval. I claim that looking at pathological distortions of time perception, such as the ADHD case, the same time duration can be experienced as shorter or longer by different subjects. So the notion of point of view is, instead,

that reason why I conclude that Present should be seen as an instant, a vision that I reinforce with Saint Augustin's remarks on time.

Interaction between subitizing, estimation and visual short-term memory

Cutini S.[1], Sella F.[2], & Zorzi M.[1]

[1] *Department of General Psychology, University of Padova, Italy,* [2] *Department of Developmental Psychology and Socialization, University of Padova, Italy*

Early visual processing is characterized by the parallel elaboration of a massive amount of information, nonetheless the number of objects that can be simultaneously tracked and memorized is surprisingly limited, as observed both in visual short-term memory (VSTM) and non-symbolic visual enumeration tasks. Here we devised a dual-task paradigm approach to address the nature and the selectivity of the link between VSTM and subitizing capacities. Verbal memory load was used as control condition and a stringent method to evaluate the individual subitizing range was employed. Our results demonstrate that VSTM load, but not verbal load, modulated performance in the subitizing range without affecting the estimation ability. This finding provides converging evidence regarding the presence of two distinct mechanisms specifically associated to subitizing and estimation. Importantly, we found a striking correspondence between the number of elements retained in VSTM and the decrement in the number of elements that can be subitized. In particular, the trade-off between VSTM load and enumeration accuracy at the subitizing limit strongly suggests that VSTM and subitizing share the same cognitive resources.

Temporal realignment of spatiotemporally distant events

Irune Fernández-Prieto[1] [2], Joel Garcia-Morera[1] & Jordi Navarra[1]

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The brain is able to realign asynchronous signals that approximately coincide in both space and time. Given that many experience-based links between visual and auditory stimuli are established in the absence of spatiotemporal proximity, we investigated whether or not temporal realignment arises in these conditions. Participants received a 3-min exposure to visual and the auditory stimuli that were separated by 706ms and appeared either from the same (Experiment 1) or from different spatial positions (Experiment 2). A simultaneity judgment task (SJ) was administered right afterwards. Temporal realignment between vision and audition was observed, in both Experiment 1 and 2, when comparing the participants' SJs after this exposure phase with those obtained after a baseline exposure to audiovisual synchrony. However, this effect was present only when the visual stimuli preceded the auditory stimuli during the exposure to asynchrony. A similar pattern of results (temporal realignment after exposure to visual-leading asynchrony but not after exposure to auditory-leading asynchrony) was obtained using temporal order judgments (TOJs) instead of SJs (Experiment 3). Taken together, these results suggest that temporal recalibration still occurs for visual and auditory stimuli that fall clearly outside the so-called temporal window for multisensory integration and appear from different spatial positions. This temporal realignment may be modulated by long-term experience with the kind of asynchrony (vision-leading) that we most frequently encounter in the outside world (e.g., while perceiving distant events).

Subjective timing of intention to act: Libet's task revisited from a first-person perspective

Han-Gue Jo[1, 2], Marc Wittmann[3], Tilmann Lhündrup Borghardt[1], Thilo Hinterberger[4], and Stefan Schmidt[1, 2, *]

1. Department of Psychosomatic Medicine, University Medical Center Freiburg, Germany, 2. Institute for Transcultural Health Studies, European University Viadrina, Germany, 3. Institute for Frontier Areas of Psychology and Mental Health, Freiburg, Germany, 4. Research Section of Applied Consciousness Sciences, University Medical Center Regensburg, Germany

In 1983, Benjamin Libet published his now famous study on self-initiated movement. He found evidence that there is a gap of around 300 ms between the onset of specific neuronal activity (the readiness potential, RP) and the subjective timing of an intention to act. Although many empirical studies are in support of Libet's findings, results are all dependent upon the accuracy of the participant's subjective report, i.e. introspection. That is, the potential inaccuracies in reporting the precise time of an intention potentially lead to misinterpretations. Many researchers see the subjective reports on mental processes as one of the big problems challenging the reliability of results. However, since research efforts are all concerned with subjective timing, we cannot dismiss introspection but rather have to more thoroughly try to control its reliability. An avenue to gain more reliable subjective reports regarding the precise moment of internal action is to work with participants who are trained in contemplative practices, such as meditation. Therefore, we propose that studying the Libet task with expert meditators can contribute to understand the neural underpinnings of subjective timing of intention to act. In addition, a single-trial analysis technique of the Libet paradigm will be performed to estimate whether perceiving an intention is correlated with spontaneous EEG activities.

Neural correlates of the reproduction of temporal intervals as revealed by MEG and EEG

Tadeusz Kononowicz[1], Tilmann H. Sander[2], & Hedderik van Rijn[1]

[1]*Experimental Psychology, University of Groningen,* [2]*Physykalisch-Technische Bundesanstalt (PTB)*

When participants are asked to reproduce an earlier presented duration, EEG recordings typically show a slow potential that develops over the central regions of the brain. This contingent negative variation (CNV) has been linked to processes such as anticipation, motor preparation and interval timing (e.g., Walter et al. 1964; Elbert et al., 1991, Macar et al., 1999). However, a still open question is whether this electrophysiological component has a magnetic counterpart (CMV). To assess the robustness of the CMV, we have conducted a temporal reproduction study while co-recording EEG and MEG. Participants were presented intervals of 2, 3 or 4 seconds, which had to be reproduced. The EEG data shows a CNV in the fronto-central areas, which develops during the whole interval. The CNV amplitude was significantly bigger for the 2 seconds condition than for the 3 and 4 seconds conditions.

Magnetic field at centro-parietal locations is initiated by the onset of the interval but dissolves after 1 second resembling initial CNV. This wave is followed by a sustained magnetic variation resembling the CMV. Both magnetic waves showed a greater amplitude for the 2 second interval. Implications of the EEG/MEG slow changes are discussed in the context of interval timing theories.

Practised time is time practised: Expertise and temporal perception

Andrew J. Latham[1,2], Bradley Patten[3,4], Lucy L. M. Patston[5] and Lynette J. Tippett[3,4]

[1]*Department of Philosophy, University of Sydney, Sydney, Australia,* [2]*Brain and Mind Research Institute, Sydney, Australia,* [3]*School of Psychology, University of Auckland, Auckland, New Zealand,* [4]*Centre for Brain Research, Auckland, New Zealand,* [5]*Unitec Institute of Technology, Auckland, New Zealand*

Correct estimation of the passage of time is important for human cognition and perception. Perception of time duration is not isomorphic to physical duration and can be affected by a number of factors including attention, arousal, emotion, predictability and stimulus context. One additional factor given little attention is 'expertise'. No single brain region appears to directly measure the passage of time. Instead, it has been proposed that the temporal passage is coded for within the spreading patterns of neural activity. Musical and video-game expertise has been shown to enhance performance at super-second timings; however, the mechanism underpinning this enhancement is not understood. Evidence suggests that both forms of expertise may reduce the lateralization of large-scale cognitive networks. Here we propose that by reducing the lateralization of a cognitive function the variability of temporal estimates generated during an experimental task is reduced resulting in more accurate temporal perception.

Effect of emotion engagement on temporal order judgment

Lingyan Wang, Taoxi Yang

Department of psychology, Peking University

Effect of emotion involvement on time perception has been widely discussed. The present study focused on the specific question whether emotion engagement may influence auditory perception of temporal order by comparing subjects' temporal order thresholds (TOTs) when exposed to different emotion stimuli. Emotion-rising stimuli we used were groups of pictures with different valence value (i.e. positive, neutral, negative) from International Affective Picture System (IAPS). In result, the effect of pictures' valence value and gender will be examined. This work will be done by June. So far data of 30 subjects has been collected.

Perceptual latency prolongation of the unattended stimulus contributes to prior entry

Jan Tünnermann[1], Anders Petersen[2], & Ingrid Scharlau[3]

1: University of Paderborn, Germany, 2: University of Copenhagen, Denmark, 3: Leuphana University of Lüneburg, Germany

The prior-entry effect, the earlier perception of an attended compared to an unattended stimulus, is based on a relative perceptual latency difference between the two stimuli. Whether or to which degree this is based on an prolongation of the processing duration of the unattended stimulus—or if the effect is caused purely by speeding up processing of the attended stimulus—is up to now unknown. We approach this question with a combination of a temporal order judgment task and a letter identification task, which is based on the Theory of Visual Attention (TVA; Bundesen, 1990). With the TVA's ability to estimate the expected encoding time in visual short-term memory, we find that prior entry results from facilitation as well as inhibition of the attended and unattended, respectively. Furthermore, we assess the time course of prior entry measured with order judgments and TVA, which depends on the interval between the peripheral cue and the target. A model that considers differential depths of processing is discussed as possible

explanation of dissociative behavior we encounter for the two measuring methods.