



Psychologie und Gehirn 2007

vom 07.06. bis 09.06.2007



Tagungsveranstalter

Deutsche Gesellschaft für Psychophysikologie und ihre Anwendung
(DGPA)

Fachgruppe Biologische Psychologie und Neuropsychologie in der
Deutschen Gesellschaft für Psychologie
(DGPs)

Institut für Arbeitsphysiologie an der Universität Dortmund
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ISBN 978-3-9808342-4-7

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Symposium 1: *Multisensory Integration in the Human Brain – Neuroimaging Studies Investigating the Interplay between Sensory Modalities*

Döhrmann, O., Naumer, M. J.

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Our daily life is characterized by ongoing interactions with objects. In such cases multiple “channels” - that is, sensory modalities - are utilized in order to coordinate our actions. For instance, a sculptor can see his artwork, *feel* its form and the heaviness of his tool, and he can *hear* whenever the tool comes into contact with the artwork. This information from different modalities is integrated in our brains, thereby providing the basis for complex actions and for the perception of coherent, “whole” objects.

Research in psychophysics and cognitive neuroscience (for reviews see Ernst and Bühlhoff, 2004; Amedi et al. 2005) has started to unravel the factors underlying this remarkable capability of the brain. Most importantly these are related to synchronicity (*time*), congruency (*space*), and meaning (*semantics*) of the stimulation in the respective sensory modalities. The last factor reflects the strong interrelation for example between a typical sight and sound of an object, which was acquired during development and learning.

Our symposium aims at elucidating how these integrative factors come into play when investigating various combinations of sensory modalities and which structures of the brain are involved in these processes. Audio-visual integration is covered by the contributions of Matthias Bischoff and Arjen Alink. While Matthias Bischoff utilized the well-known ventriloquism effect in an experimental paradigm combining EEG and fMRI, Arjen Alink will report the results of an fMRI study on visual and auditory motion perception. Hannah Helbig’s contribution will focus on visuo-tactile integration and the influence of the reliability of information from the respective sensory modalities. Finally, Marcus Naumer will report results from fMRI experiments investigating contributions of the cerebellum to object-related visuotactile integration.

In sum, our symposium shall give an overview of recent work in sensory neuroscience which goes beyond traditional approaches focusing on our senses in isolation.

Audio-visual binding - hemodynamic and electrophysiological correlates in a congruency-task

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To investigate the percept of audio-visual binding, simple visual and auditory stimuli were presented synchronously or asynchronously. The ventriloquism effect – the localization of a sound is biased by and towards a simultaneous visual stimulus – was used as an indicator for the influence of crossmodal binding. fMRI and EEG were recorded during task performance in order to reveal activation in areas discussed to be involved in multisensory processing in the literature and to identify correlates of crossmodal binding in EEG-spectrograms.

Contrasting trials with reported ventriloquism-effect vs. the no-binding condition revealed activation in the right insula, superior temporal sulcus and parieto-occipital sulcus. Implementing the ventriloquism-effect allows us to relate these activations to the percept of consciousness-related binding processes. The parameter values extracted from EEG spectrograms of the trials of the experimental condition were higher than those of the control condition. So, in fMRI and EEG percept-related correlates could be identified.

Capture of auditory motion by vision is represented by an activation shift from auditory to visual motion cortex

Alink, A.¹, Singer, W.², Muckli, L.^{1,2,3}

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Using fMRI we have investigated the Cross-Modal Dynamic Capture (CMDC) illusion: hearing a sound moving consistently with a visual motion stimulus while in reality the sound moves in the opposite direction. To this end we compared BOLD responses for two types of trials: trials in which auditory motion was correctly perceived as moving in the opposite direction as the visual stimulus and CMDC trials in which subjects falsely perceived the auditory stimulus as moving coherently with the visual stimulus. To test if this illusion has an effect on the perceptual stage of motion processing, we tested for effects in the early motion processing areas hMT/V5+ and auditory motion complex (AMC). Our main finding was that CMDC decreases activity in bilateral AMC and increases activity in the left hMT/V5+. Furthermore, we found that motion coherency increases activation in bilateral hMT/V5+ and in the right AMC.

Thus, audio-visual motion integration influences the perceptual stage of motion processing. In contrast, conflicting motion increases fronto-parietal activation which possibly reflects decisional processes.

In sum, we interpret the observed activation shift from auditory to visual motion areas during CMDc as reflecting a competition between senses for the final motion percept that is possibly regulated by attention.

Neural systems involved in visual-tactile integration of shape information

Helbig, H. B., Noppeney, U. Ernst, M. O.

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The brain integrates multisensory information to create a coherent and more reliable perceptual estimate of the environment. This multisensory estimate is a linear combination of the individual unimodal estimates that are weighted by their relative reliabilities (e.g., Ernst and Banks, *Nature*, 2002).

Here we explored the neural substrates underlying visual-tactile integration in shape processing. To identify multisensory integration sites, we correlated behavioral data with neural activity evoked by multisensory integration.

Observers were presented with elliptical shapes that they could see and/or touch. Observers' task was to judge the shape of the ellipse. Introducing conflicts between seen and felt shape allowed us to examine whether participants relied more on visual or tactile information (relative weight of vision and touch). To manipulate the weight attributed to vision, we degraded visual information.

We observed a decrease in visual weight when vision was degraded and thus became less reliable. Discrimination performance increased when both modalities were presented together, indicating that visual and tactile shape information is indeed fused. BOLD response bilaterally in the anterior IPS is modulated by visual input. BOLD-signal changes in these areas correlate with cue weights, suggesting that activity reflects the relative weighting of vision and touch.

Object-related visuo-tactile integration in the human cerebellum

Naumer, M. J., Yalachkov, Y., Polony, A., Ratz, L., Döhrmann, O., Kaiser, J.
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While it is widely accepted that temporal and parietal cortices are prominently involved in visuo-tactile integration (VTI), a potential contribution of the human cerebellum remains to be determined. In three fMRI experiments, we presented meaningful (toy animals) and artificial 3D objects (wooden "fribbles"), while controlling for potential cue and motor confounds using a 'no-stimulus' baseline condition (M). We searched for VTI regions that were activated by both unimodal visual and tactile conditions ($V > M$; $T > M$), and additionally responding more strongly to bimodal visuo-tactile stimulation than to each of the unimodal conditions ($V < VT > T$). Furthermore,

we manipulated the side of active touch (left vs. right hand) and the degree of VT (orientation or identity) congruency. A bilateral region of the lateral cerebellum showed robust VTI effects that were substantially more pronounced during stimulation of the ipsilateral as compared to the contralateral hand. These effects neither depended on the degree of VT congruency nor on the type of stimulus material. In the course of additional tests for audio-visuo-tactile (AVT) integration in this region we neither found the A>M nor the AVT>VT criteria to be fulfilled. We thus conclude that the integrative role of the lateral cerebellum might be specific to VT integration.

Symposium 2: *Psychology and Olfaction*

van Thriel, C.

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For decades, the chemical senses were neglected by academic research but recently there is growing scientific evidence that odors might influence human behavior in various ways. Odor processing is often unconscious and the consequences of living or working in odorous environments are often subtle. The four talks of the symposium will focus on different aspects of olfactory processing/ impact.

Olfaction is not the sole pathway of signal transduction to the brain. The trigeminal system interferes with the olfactory system but this mutual crosstalk still bears many secrets. During the processing of odor signal from the environment cognition might amplify or mitigate perceptions. These information processing stages are currently under investigation. Like for other mammals human body odors might also play an important role in non-verbal, interpersonal communication like signalization of emotions (fear, sympathy) or fertility. Biopsychology is currently investigating these processes. People feel annoyed by certain environmental odors and interferences with performance are either reported or expected. The scientific evidence for such distractive odor effects is far from being conclusive and some study results will be reviewed.

In more details the speakers will address:

- (a) Interactions between olfactory and trigeminal chemoreception
- (b) Top-down processing and odor perception
- (c) Chemosensory communication of emotion
- (d) Chemoreception and cognitive performance

Interactions between olfactory and trigeminal chemoreception

Hummel, T.

Universitäts-HNO Klinik, TU Dresden

The intranasal trigeminal and the olfactory system are intimately connected. There is evidence showing that acquired olfactory loss leads to reduced trigeminal sensitivity due to the lack of a central-nervous interaction. Both, the orbitofrontal cortex and the rostral insula appear to be of significance in the amplification of trigeminal input which is missing in patients with olfactory loss. On peripheral levels, however, adaptive mechanisms seem to produce an increase in the trigeminal responsiveness of patients with hyposmia or anosmia.

Top-down processing and odour perception

Smeets, M.

Utrecht University

The sense of smell has been referred to as a malleable sense, meaning that it is especially sensitive to outside influences. In case of the evaluation of possible health consequences from odour exposure, top-down influences of pre-existing cognitions about odours and health can influence perceptions of intensity or pleasantness of the odour on the one hand and the experience of health effects on the other. In this presentation the various ways in which top-down processing can alter perception will be outlined and illustrated with research data.

Chemosensory communication of emotion

Pause, B. M.

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Similar to most socially living phyla, also humans seem to communicate emotional states via chemosensory signals. Here, we investigated (1) how chemosensory anxiety signals affect perception and physiology of the perceiver, (2) whether chemosignals produced by anxious and aggressive subjects, differently affect the physiology of the signal perceiver and (3) whether socially anxious subjects (SAS) respond to chemosensory anxiety signals in a different way than non-anxious subjects. In order to obtain anxiety-related chemosensory signals, axillary sweat samples were taken from university students before an academic oral examination. Aggression-related chemosignals were sampled from the winners of a badminton contest. The chemosensory stimuli were presented to the subjects via a constant-

flow olfactometer. In healthy subjects chemosensory anxiety signals are processed advantageously (early components of the chemosensory event-related potential) and increase the startle reflex. However, there is no effect on the skin conductance response (SCR). In contrast, aggression-related chemosignals do not change the startle reflex but increase the SCR. The effect of chemosensory anxiety signals on the startle reflex was much more pronounced in SAS subjects than in the control group.

Chemoreception and cognitive performance

van Thriel, C., Juran, S. A.

Leibniz Research Centre for Working Environment and Human Factors Inhalt der

The effects of ambient odors on cognitive performance are ambiguous. Some studies reported increase performance scores mainly attributed to the arousing properties of the investigated odors; others found reduced performance maybe caused by distraction effects of the investigated odors. In occupational settings where odorous chemicals are regulated by occupational exposure limits the problem of interferences between malodors and attention has been recognized but studies addressing this problem are rare. In the present study, cognitive performance of 24 male and female volunteers was investigated during acute experimental exposures to cyclohexylamine (fishy odor) in concentrations as high as the German occupational exposure limit (10 ppm). Various cognitive functions, like response inhibition, divided attention and response shifting were tested by neuropsychological tests. Compared to the odorous control condition (1 ppm) the analysis of the perceptual ratings (e.g. odor annoyance or pungent) revealed significantly higher scores during 10 ppm exposures. In contrast, all indicators of cognitive performance remained unchanged during the annoying 10 ppm condition. Even the most annoyed subjects showed no impairment of attentional functioning and thus distractive effects appeared to be unlikely for cyclohexylamine. Nevertheless, the interaction between odors, especially unforeseen environmental odors, and performance need to be investigated more systematically.

Symposium 3: *Why Sex Hormones Matter for Neuroscience*

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A large number of studies indicate sex differences in the brain and its functional organization. Although the nature of these sex differences are not fully understood, there is increasing evidence that sex hormones are significantly involved in the development of sexual dimorphisms, the functional cerebral organisation and behaviour. It is known that sex hormones have organizing effects on neuronal development beginning in uterus as well as activating effects throughout lifetime. The majority of studies investigating organizing effects of sex hormones examine sexual dimorphisms prenatally and in early childhood. Little is known about the organizing effects of sex hormones on the developing brain during puberty. This is of particular interest because it has been shown that several cognitive sex differences initially appear in this period. Although the majority of sexual dimorphisms are established after puberty, other studies have shown that the neuromodulatory properties of sex hormones can lead to dynamic changes in the functional organisation of the brain. For example, it is known that natural fluctuation of sex hormone levels during the menstrual cycle can modulate functional cerebral asymmetries and the interhemispheric crosstalk. Moreover, sex hormones are related to cognitive performance. Besides hormone fluctuations within the physiological range, studies have investigated activating effects of sex hormones on cognitive performance in subjects who receive atypical high doses of sex hormones for clinical reasons. These studies indicate that specific aspects of spatial abilities, in particular, are sex-sensitive and under sex-hormonal control. Furthermore it has been shown that levels of sex hormones, such as estradiol, progesterone, and testosterone, are not only related to spatial performance but also to cognitive strategies which are applied to spatial problems. These results indicate sex hormones have tremendous effects on the neuronal organization and various brain functions.

Sex differences and the impact of steroid hormones on the developing human brain

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Little is known about hormonal effects of puberty on the anatomy of the developing human brain. In a voxel-based morphometry study, gender differences in gray matter volume were examined in 46 children and adolescents aged 8 to 15 years (M = 11.3, SD = 2.1) and related to steroid hormones collected from serum samples. Boys showed larger gray matter (GM) volume in the right middle temporal gyrus and the left amygdala. By contrast, girls had larger right striatal and bilateral hippocampal GM volumes than boys. While amygdala volumes were correlated with testosterone levels across both genders, GM volumes of parahippocampal structures were associated with estrogen levels in girls. In addition, testosterone was significantly correlated with the GM volume of fronto-parietal regions in both sexes. No significant correlation was found between steroid hormones and striatal GM volume. The data suggest that pubertal hormones have organizational effects on the developing human brain.

Sex-hormonal modulation of interhemispheric integration

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Previous research has shown that fluctuating levels of sex hormones modulate the cerebral organisation of various brain functions. Specifically, it has been shown that high levels of estradiol (E) and progesterone (P) reduce functional cerebral asymmetries, probably due to its neuromodulatory properties on interhemispheric cross-talk. However, only a minority of these studies used tasks that cannot be performed without interhemispheric interaction. In the present study, two interhemispheric integration tasks were used in which subjects were asked to match

letters according to physical (e.g. A vs. A) and name identity (e.g., A vs. a). Matching stimuli were presented either within or across visual half-fields. Seventeen spontaneously cycling women were tested during menses (low levels of E and P) and during the luteal phase (high levels of E and P). Saliva levels of E and P were analyzed using chemiluminescence assays. In agreement to previous studies, the more demanding name-identity task revealed a robust across field-advantage (AFA) in response times. Moreover, AFA was reduced during menses, indicating an enhanced interhemispheric integration during the luteal phase. The results suggest that the magnitude of interhemispheric integration is modulated by sex hormones and fluctuates across the menstrual cycle.

Domain specific enhancements of spatial abilities by unphysiological estrogens and progesterone levels

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Spatial abilities were studied in 40 patients recruited from a reproductive clinic and compared to controls. Controls were studied during menses. Blood samples were taken from patients and controls, respectively. Patients received a regime of estrogen stimulation for follicle development. At day 10 – 15 of the treatment cycle the mean serum estradiol concentration was 30fold compared to controls. At day 30 of hormone stimulation the estradiol was still enhanced but additionally serum progesterone concentration was 450fold compared to normal. We found correlations between elevated progesterone and performance in three dimensional mental rotation tasks and between progesterone and a measure for visuoconstruction. Moreover high progesterone was associated with significantly higher depression rates in these patients. Elevated estradiol correlated with fewer errors in an object-in-location-memory task.

Our results confirmed and extended present knowledge about the role of estradiol in spatial abilities. With respect to progesterone a possible role for three-dimensional rotation should be investigated in more detailed experiments.

Sexual hormones influence strategy choice in virtual navigation and performance in mental rotation

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Sexual hormones are thought to influence spatial abilities. Animal studies demonstrated that rats choose different orientation strategies depending on

circulating estradiol. To our knowledge there is no study investigating an association between sexual hormones and orientation strategies in humans.

In the present study, 63 students aged 20-35 years (22 men, 20 women taking contraceptives, and 21 spontaneous cycling women in their mid-luteal cycle phase) were investigated for their mental rotation performance (MRT, Peters et al. 1995) and their individual strategy in a virtual maze. Subject's saliva was collected before and after testing to analyse concentrations of estradiol, progesterone, and testosterone.

In agreement with previous studies the testosterone level was associated positively with the performance in the MRT in men. For the navigational task two different strategies were determined. One strategy comprised subjects with an external strategy which relied more on external landmarks. The internal representation of the maze was typical for subjects using a second strategy. A third group of subjects could not be assigned to either strategy. The use of an external strategy was positively correlated with the progesterone level in spontaneous cycling women. These results indicated that use of a spatial strategy is modulated by sexual hormones.

hormones

Symposium 4: *Behavioral Genetics*

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This symposium is conducted to compile recent findings relating gene polymorphisms to different aspects of behavior, cognition and emotion. Moreover, genes of interest relate to neurotransmitter systems histamine, dopamine and serotonin (Reuter, Montag, Mueller Pauli, Hennig) or hormone receptor functioning (Wuest). Single gene polymorphisms will be demonstrated to be related to psychopathology on the one hand and to distinct aspects of behavior (cognition, emotion, hormone responses) on the other. Moreover, most of the studies are going beyond the classical association studies between genes and self-reports by investigating objective behavior in experimental sessions including stress research or pharmacological stimulation. The symposium aims at demonstrating that molecular genetic approaches not only explain individual differences but also deepen our understanding of basic psychophysiological responses and their behavioral manifestations.

The role of a Functional Polymorphism of Histamine N-Methyltransferase (HNMT) for Alcoholism

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CNS histamine has been shown to have an inhibitory effect on reward and it is implicated in the etiology of addiction and stress. Histamine N-methyltransferase (HNMT) is believed to be the sole pathway for termination of the neurotransmitter action of histamine in mammalian brain. A common, functional polymorphism, a C314T transition in the HNMT gene, results in a Thr105Ile substitution of the protein encoded. A recent study has shown that the frequency of the Ile105 allele was significantly lower in alcoholics compared to that in non-alcoholics in Finns and Plains American Indians. Following up these results, we tested whether the Thr105Ile polymorphism was associated with alcoholism in German Caucasians.

Thr105Ile was genotyped in $n = 366$ psychiatrically interviewed German Caucasian ICD-10 lifetime alcoholics, along with $n = 200$ ethnically matched controls. No significant difference was found in the frequency of the Ile105 allele between alcoholics (0.11) and controls (0.10) ($\chi^2 = 0.21$, $df = 1$, $p = 0.647$). Likewise, genotype distributions did not differ significantly. However, the frequency of the Ile105 allele was significantly lower in male alcoholics with a family history of alcoholism compared to that in male alcoholics without a family history of alcoholism ($\chi^2 = 4.07$, $df = 1$, $p = .044$) supporting the protective role of the Ile105 allele against alcoholism.

Sex Specific Association between GR Polymorphism A3669G in Exon 9beta and Working Memory Performance

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Cortisol has a modulatory influence on cognitive functions in humans. Both impairing and enhancing effects of cortisol administration have been shown for hippocampus dependant declarative memory and impairing effects have been shown for prefrontal dependant working memory function.

Given the high density of glucocorticoid receptors in the prefrontal cortex, we investigated whether common variants of the glucocorticoid receptor gene (ER22/23EK, N363S, BclI, 9beta) modulate the influence of cortisol administration on working memory. Working memory performance was investigated in 162 subjects following administration of 10mg hydrocortisone and following placebo administration using an item-recognition memory task.

No impairing effect of hydrocortisone treatment became evident. However, a general and sex specific association of the 9beta AG variant with working memory performance was observed. While 9beta AG women displayed faster reaction times than male and female carriers of the other polymorphisms, 9beta AG men were

relatively slower (sex by genotype interaction $p=.02$) compared to the other genotypes.

Heritability estimates for memory are roughly 50%, indicating that common genetic polymorphisms have an important impact on cognitive performance. Our results indicate that variants of the GR gene might explain some of the variance attributable to genetic factors.

Affective startle reflex modulation, genes and personality: The role of the functional COMT Val158Met polymorphism

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Emotional dysregulation is a core characteristic in psychiatric diseases. There is evidence that variability in anxiety related traits and anxiety disorders have the same biological underpinnings. Experimental paradigms like the prepulse inhibition (PPI) and the affective startle reflex modulation (ASRM) gave new insights into the psychophysiological and neuroanatomical mechanisms involved in the processing of emotions, of which the neurochemical basis is still a matter of debate. Therefore, testing the involvement of neurotransmitter related candidate genes with respect to ASRM and anxiety related personality traits is a promising approach.

In $N = 96$ healthy subjects recruited out of a sample of $N = 800$ subjects according to their genotypes we tested the association between the DRD2 Taq 1a, the COMT Val158Met and the 5-HTTLPR (SLC6A4) polymorphisms and the magnitude of the eye-blink reflex in an acoustic ASRM and a PPI paradigm. Positive, negative and neutral pictures served as modulators of the startle reflex.

None of the gene loci was related to PPI. However, in response to negative stimuli in ASRM, subjects without a Val-allele, having lowest COMT enzyme activity, exhibited a tremendously potentiated startle reflex as compared to carriers of the Val-allele ($p<.001$). Neither the DRD2 Taq 1a nor the SLC6A4 predicted ASRM. Furthermore, the anxiety related personality trait BIS (behavioral inhibition system) showed an increased startle response to pleasant and to unpleasant stimuli which supports the revised reinforcement sensitivity theory by Gray & McNaughton (2000) relating anxiety (BIS) to the process of conflict detection irrespective of the affective valence.

Dopamine D4 receptor (DRD4) gene polymorphism modulates emotional-motivational significance of standardized pictures as assessed with the startle method

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Affect modulation might be an endophenotype associated with a polymorphism of the human dopamine receptor D4 (DRD4) gene. Since the presence of the seven-repeat (7R) allele of this polymorphism was expected to lead to reduced emotional

responding, the affect modulated startle was examined in 100 healthy volunteers, 66 lacking a DRD4 7R allele (7R-absent group) and 34 with at least one DRD4 7R allele (7R group). Most important, an affective startle modulation - in accordance with the literature with enhanced startle responses in the context of unpleasant stimuli (pictures) and reduced ones in the context of pleasant stimuli - was only found in the 7R-absent group. Subjects with a DRD4 7R allele exhibited no affective startle modulation; in comparison to the 7R-absent group their startle responses were reduced with unpleasant stimuli and enhanced with pleasant stimuli, while responses to neutral stimuli did not differ. Polymorphisms of catechol-o-methyltransferase (COMT), serotonin transporter (5-HTT) and dopamine transporter (DAT1) were not associated with the affect modulated startle response.

The present study is to our knowledge the first evidence of a genetic influence on affective startle modulation in humans. Affective startle modulation may serve as an endophenotype underlying disorders with a derangement of emotionality.

The stress response in association with the serotonin transporter gene variation

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Biopsychologie/TU Dresden

Dysfunction of the serotonin (5-HT) system for humans carrying the short and low expressing allele (s) has significant links with depression, anxiety and neuroticism. Carriers of the long and full expressing allele (l) have been reported to show an increased cardiovascular reactivity and greater risk of myocardial infarction. Very recent studies suggest that due to the A/G SNP within the 5-HT transporter polymorphism, only the LA allele is high expressing. Furthermore, higher amygdala neuronal activity in low expressing carriers has been demonstrated, which could be linked to differences in acute, stress responses. 112 adults (mean age: 24 years) and 116 children (mean age: 9 years) were exposed to the Trier Social Stress Test (TSST). Cortisol levels were determined from saliva samples obtained 2 minutes before and 2, 10, 20 and 30 minutes after the stress exposure, respectively. The DNA was extracted from saliva samples for genotyping the higher (LA) and lower (LG, S) expressing alleles. Contrary to previous reports, adults carrying the higher expressing alleles (N=31) of the 5-HTT polymorphism revealed a significantly higher cortisol response to the TSST than individuals carrying the lower expressing allele (N=81), ($p < .05$). Similar results were observed in children ($p < .05$). Contrary to expectations, increased amygdala responsiveness observed in lower expressing 5-HTT allele types appears to be linked to a relatively low adrenocortical response to psychosocial stress.

Interactions between different gene-polymorphisms of the serotonin system relate to endocrine stress responses and dispositional coping

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Several studies indicate that especially the polymorphism of the SERT (5-HTTLPR) relates to anxiety and neuroticism although the literature is not homogenous in this respect. This research is mainly based on questionnaire data although some experimental approaches are available as well. However, data on stress responses especially in the context of experimentally induced social anxiety are rare. We therefore investigated the questions whether the 5-HTTLPR gene polymorphism relates to cortisol responses after public speaking in N=100 healthy male volunteers. The outcome was negative which can be explained by the fact that synaptic functioning is characterized by a high amount of plasticity. Especially studies in SERT - knock out mice reveal that other aspects of serotonin neurotransmission are changed in these animals probably to compensate for the genetic deficiency. We therefore investigated whether interactions between polymorphisms of different regulating structures are more suitable to get information about synaptic efficiency. The gene polymorphism of the 5-HT_{1a} -receptor C(-1019)G alone did also not relate to cortisol responses after stress but the combination between the homozygotic L-allele of the 5-HTTLPR and the C-allele of the C(-1019) polymorphism for the 5-HT_{1a} receptor was associated with a complete lack of cortisol responses, with much higher baseline cortisol levels and with increased ratings on anxiety compared to all other groups although this particular configuration was very rare (N=7). Data will be discussed with respect to the usefulness of combining different gene polymorphisms involved in synaptic regulation.

Symposium 5: *Psychophysiological Methods in Psychiatry*

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During the last decades new techniques like event-related potentials (ERP) and transcranial magnetic stimulation (TMS) have been devised in order to visualize and measure brain activity. In addition to these new technical developments, there is a long psychophysiological tradition in psychiatry originating from the so-called “first biological psychiatry” (Shorter) in the 19th century.

The aim of the present symposium “(Electro-)physiological methods in psychiatry” is to give a short survey on “old” and “new” empirical approaches in the context of psychiatric diseases.

- In the first lecture PD Dr. Ebert gives some examples of (psycho-)physiological methods in psychiatry.
- In the second lecture Dr. Kaiser speaks about ERP correlates of inhibitory functions and their changes in psychiatric disorders.
- In the third contribution Dr. Schönfeldt will talk about the application of transcranial magnetic stimulation in psychiatry.
- The last two lectures of Dr. Kaiser and PD Dr. Ruchsow deal with ERP techniques reporting results from different psychiatric patient groups.

Influence of lateralized nostril breathing on central nervous activity

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There are several recommendations of breathing techniques by the Indian Hatha-Yoga system for preparing mental concentration. One of them is the lateralized airflow through a particular nostril. It is not known, whether and why lateralised airflow influences central nervous activity. Therefore the following experiment was designed: In 18 subjects (19 – 25) valves were placed into their nostrils, which led the inspiration through the left nostril and the expiration through the right nostril. In a second experiment the direction of air stream was changed. Immediately before each experiment the subjects had to breathe normally to obtain a baseline, sequence was randomized. The subjects were investigated in a relaxed and awaked condition. The e.e.g. was recorded by eight electrodes, selected out of the 10-20-system. For signal analysis a fast Fourier transformation was used, the power of alpha-, beta- and theta-frequency bands was calculated and subject to a statistical analysis.

During inspiration through the right and expiration through the left nostril an increase of amplitude in almost all derivations and frequency bands was found compared with breathing through both nostrils (baseline). This effect was statistically significant ($p < 0,05$). No significant effect was detectable during breathing in the other direction. It seems that the central nervous activity level is influenced by selective inspiration through the right nostril and expiration through left nostril only. Morphological and functional implications are discussed.

Electrophysiological correlates of inhibitory processes in psychiatric disorders

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Goal-directed behaviour requires a variety of inhibitory processes. Response inhibition is the act of withholding an inappropriate motor response, which can be tested in Go/Nogo- and stop-signal-tasks. Another important inhibitory process is interference control, i.e. the suppression of irrelevant stimulus dimensions, which is classically addressed in Stroop- and related tasks. A series of neuroimaging and electrophysiological studies has contributed to a differentiated view on the spatiotemporal activation pattern involving mainly the lateral prefrontal cortex and the anterior cingulate gyrus. On a behavioural level, inhibitory processes have been shown to be disturbed in patients with schizophrenia and major depressive disorder. This can result in an impairment of goal-directed behaviour characterized by a loss of flexible adaptation of behaviour and increased distractability. Despite similarities in behavioural performance event-related potentials can be used to differentiate spatiotemporal activation patterns that are characteristic for specific groups of

patients. Event-related potential data from Go/Nogo- and Stroop-tasks will be presented in support of this hypothesis.

Transcranial magnetic stimulation in psychiatry and neurosciences

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Universitätsklinik Ulm

The beginning of the transcranial magnetic stimulation (TMS) traces back to the eighties of the last century to Sheffield, when A. Barker and colleagues created the first stimulator that could be used for diagnostic purposes. Based on electromagnetic fields, TMS shows a great advantage because of their property to interfere, non-invasively and quite painless, with the brain function. Because of the very good time resolution (in the range of few ms.) and the modest spatial resolution TMS offers in the field of neurosciences a very comfortable way to prove hypotheses with regard to the information processing of higher cognitive functions. Since 1988, TMS can be used in repetitive form (rTMS) with frequencies up to 100Hz. Depending on the stimulation parameters (e. g. frequency, intensity, train length) rTMS is able to cause long-term-potential/ LTP or –depression/ LTD like phenomena. These long lasting effects have been tested for therapeutic purposes since more than 15 years. Because of the analogy to ECT, rTMS has predominantly been used to treat depression. Meanwhile, rTMS has been tested in other disorders or syndromes like schizophrenia, OCD, mania, PTSD and conversion disorders among others. Although TMS is a fascinating technique, we are even now far from understanding its potential as a therapeutic tool. On the other hand TMS plays today a significant role as a research tool for understanding brain function, connectivity and plasticity, in particular when combined with functional imaging methods.

Error processing in patients with obsessive-compulsive and borderline personality disorders

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Obsessive-compulsive disorder (OCD) as well as borderline personality disorder (BPD) have been related to deficits in action monitoring and error processing. Three ERP components have been discussed in the context of error processing: the error negativity (Ne) and the “early” error positivity (Pe) reflecting automatic error processing and the “late” Pe which is thought to mirror the awareness of erroneous responses.

11 patients with OCD, 12 patients with BPD, and two age- sex- and education-matched control groups performed a Go/Nogo task while a 64 channel EEG was recorded. Artifact-free EEG-segments were used in order to compute ERPs on correct Go trials and incorrect Nogo trials (i.e. errors of commission), separately.

Patients with OCD showed enhanced (more negative) Ne amplitudes while patients with BPD demonstrated smaller (less negative) Ne amplitudes compared to respective control groups. With regard to the two Pe components there were no group differences.

These findings indicate that the Ne amplitude is sensitive to psychopathological abnormalities suggesting a continuum of impulsivity and compulsivity in OCD and BPD patients.

Symposium 6: *Neural Correlates of Working Memory: Evidence from fMRI Studies*

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Working memory (WM) is an essential cognitive ability that allows the retention of information for short periods of time, thus making it available for the active guidance of behaviour. According to cognitive models, WM comprises separate, capacity-limited buffers for the storage of different types of information. Neurophysiological data suggest that this domain-specific storage is mediated by the same brain structures that process perceptual information. In this symposium we address the questions of where in the brain information from diverse modalities is stored and which processes limit WM capacity. The first three contributions will show that maintenance of verbal, haptic and movement representations are indeed mediated by distinct domain-specific neural systems as revealed with fMRI. Christian Fiebach will show that the representational basis for verbal WM maintenance is formed in a brain area, which is also involved in phonological analyses of spoken speech. Amanda Kaas will show that different neural pathways subserve the storage of tactile micro- and macro-spatial object characteristics such as texture and orientation. Annerose Engel will present data showing that the short-term storage of meaningless hand and artificial non-biological object movements elicits activation patterns that partially overlap with the mirror neuron system, a system which is critically involved in the observation of actions. Finally, the last two contributions will focus on the visual domain and the processes limiting WM capacity. Jutta Mayer will present fMRI data focusing on the encoding phase of a WM task. In particular, she will show that the limitation of visuo-spatial WM is due to common neural resources shared by WM and selective attention. Christoph Bledowski will report fMRI and EEG results of the retrieval phase indicating that greater target-probe similarity and higher memory load increase recognition difficulty by tapping similar neuronal resources.

Bottom-up phonological speech perception mechanisms are involved in verbal working memory: An fMRI study

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The multicomponent model of working memory (WM) postulates a passive phonological store in the left inferior parietal lobe. This model is supported by neuropsychological data, but only partly compatible with neurocognitive models of language as these do not assume passive storage functions in parietal cortex. However, these models assume phonological representations in superolateral temporal cortex (STG) that are involved in the analysis of speech. We use functional magnetic resonance imaging (fMRI) to explore the contribution of phonological representations in STG to verbal WM maintenance. In a localizer experiment, we identified temporal regions involved in phonological analyses of spoken speech. In an independent fMRI experiment, the contribution of these phonological regions to verbal maintenance was explored by varying stimulus type (words/pseudowords) and WM load. During verbal maintenance, subregions of these phonological regions showed sustained activation. Activation profiles of these 'delay voxels' closely mirrors the behavioral difficulty of the WM task.

These data indicate that verbal working memory relies on principles that were previously identified in visual working memory studies in nonhuman primates, i.e. on the sustained activation of long-term memory representations ("active memory"; Fuster, 1995). In this sense, posterior language representations form the representational basis for verbal working memory.

The neural correlate of haptic working memory for micro and macro spatial object features

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Skillful object manipulation depends on adequate cognitive processing of tactile micro and macrospatial object characteristics such as texture and orientation. While large systematic errors occur in haptic (active tactile) macro spatial tasks, such as orientation matching, the tactile sense has been shown to be optimally adapted for micro spatial tasks, e.g. texture discrimination. Not much is known about the neural substrates involved in macro and micro spatial tasks. The processing of tactile orientation versus texture might involve different neural pathways. We investigated the neural bases of working memory for tactile orientation and texture in two functional magnetic resonance imaging (fMRI) experiments.

We found that tactile orientation working memory was subserved by primary somatosensory, left anterior prefrontal and parieto-occipital areas, each important at different stages in the working memory delay. Tactile texture working memory, on the other hand, was supported by bilateral anterior parietal areas and right dorsolateral prefrontal cortex, which showed increasing activation for higher working memory loads. Taken together, these results provide preliminary evidence that distinct neural pathways support micro- and macrospatial tactile working memory.

Activation of the mirror neuron system while processing hand and object movements in a perceptual working-memory task

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Observing actions performed by other humans activates the so-called mirror neuron system (MNS, ventral premotor area, inferior parietal lobe), while observation of nonbiological movements elicits activity mainly in areas known for visual movement analysis (occipito-temporal junction). Using event-related fMRI we tested whether encoding and retention of meaningless hand and artificial non-biological object movements evoke overlapping cortical activation patterns, especially within the MNS. During a delayed matching-to-sample task participants encoded (6s) and maintained (8s) three movements of one movement type and decided whether a test stimulus belonged to the memory set. One baseline (static hands/ objects) and three experimental conditions with increasing difficulty were constructed for each type of memory material.

For encoding a random effect analysis of the fMRI data revealed overlapping (within the areas of the MNS and visual movement analysis) as well as distinct (supplementary motor area for hand movements, a part of the right supramarginal gyrus for object movements) activation foci for the two movement types. During retention the hemodynamic responses were located in frontal and parietal areas for both movement types and did not overlap. These results suggest that hand and non-biological object movements share common mechanisms during encoding but different mechanisms during retention.

Neural correlates for encoding into spatial working memory and selective attention: Evidence for interference

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Humans are severely limited in their ability to memorize visual information over short periods of time. Selective attention has been implicated as a limiting factor. In this study we used functional magnetic resonance imaging to test the hypothesis that this limitation is due to common neural resources shared by visual WM and attention. We combined visual search and delayed discrimination of spatial locations and independently modulated the demands on selective attention and WM encoding. Attention was manipulated by the difficulty of the search, and WM load was varied parametrically (1, 3 and 5 locations).

A random effects analysis of the fMRI data revealed overlapping activation for attention demanding visual search and spatial WM encoding in distributed posterior and frontal regions. Several visual, parietal and precentral areas were reduced in their memory load response under the condition with high attentional demand. Pure effects of WM load and attentional demand were found bilaterally in the prefrontal cortex for WM and the visual cortex for attention. These results indicate that encoding into spatial WM and visual attention require to a high degree access to common neural resources and may define the neural locus of a processing bottleneck of spatial WM and attention.

Differential effects of load and target-probe similarity on short-term memory retrieval: A combined fMRI and ERP study

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During retrieval from short-term memory, higher memory load increases the number of comparisons to be made, whereas greater target-probe similarity requires a more precise item matching. It is unclear whether these two processes tap similar or different resources. The present study tested the effects of load and target-probe similarity in the recognition phase of a delayed match-to-sample task. Either 1 or 3 colours had to be memorized. After a delay phase, a single probe colour was presented which either matched, was similar or was dissimilar to the learned colour(s).

Both high load and high similarity increased recognition difficulty. Moreover, while load had no effect on recognition of dissimilar stimuli, error rates and response times were increased both for similar lures and matches under high load. fMRI revealed

significant load and similarity effects in the ventral and dorsal lateral prefrontal cortex (PFC) and medial frontal areas. Ventrolateral PFC showed an additional interaction effect with similar lures leading to stronger activation than matches under the low load condition only. Modelling the ERP-source activity of VPLFC revealed that this interaction was evident at about 350 ms after probe presentation. We propose that ventrolateral PFC reflects control processes of selecting targets among competing items.

Symposium 7: *Psychophysiology in Occupational Medicine*

Freude, G.

Federate Institute for Occupational Safety and Health, Berlin

Occupational Medicine is a preventively oriented discipline which is focused on investigation and assessment of the interaction between the demands and conditions at work and human health and well-being. In the modern world of work, mental workload and stress and its influence on human health and well-being is increasingly important. Psychophysiological methods enable the evaluation of cardiovascular or central-nervous reactions in both short, simulated laboratory tasks or longer several-hour tasks based on daily life work. This symposium is focused on studies of cardiovascular parameters (HR, HRV, BP) which are useful in assessing operator's activation because mental strain is accompanied by dynamic changes in the autonomic nervous system.

The four presentations refer to the following issues:

- (1) The subjectively perceived exertion and the differences in cardioactivity under mental load. Particularly, it was investigated whether there are correlations between subjectively perceived exertion and cardioactivity under mental workload. This study is based on heart rate variability and blood pressure analysis from 169 subjects (Irina Böckelmann, Institute for Occupational Medicine, University of Magdeburg)
- (2) HRV as a noninvasive tool for workload assessment in occupational medicine. The aim of this study was to map the relationship between subjective workload and objective physiological measures using a non-linear, fuzzy based model (Matthias Weppert et al., Institute for Preventive Medicine, University of Rostock)
- (3) Psychophysiological associations of noise in educational occupation. In this investigation noise and its effect on heart rate and well-being were observed in 41 pedagogues in five different occupational fields (Reingard Seibt et al.,)
- (4) Age-related effects on cognitive flexibility and cardiovascular activity among managers in the steel industry. Cardiovascular parameters (BF, HR, HRV) of managers of two different age groups were studied in a task-switching paradigm to analyse aging effects as well as mechanisms of compensation and adaptation during task performance and recovery.

Subjectively perceived exertion and differences in cardioactivity under mental load

Böckelmann, I.

Institut für Arbeitsmedizin, Otto-von-Guericke-Universität Magdeburg

In a psychophysiological study only a complex observation allows a full characterization of the situation of the examination and the total strain during exercise. In the occupational medicine the multilevel concept from Fahrenberg is very important. This consists of the three levels: psychometrical performance, real measured strain reactions and subjectively perceived exertion of load. In many examinations in occupational medicine with physical load there is used the methodical proved Borg Scale, a valid measure of relative intensity often used in exercise stress testing; in bicycle-ergometry it is standard (Guidelines of the American Heart Association). Normally the perceived exertion states something about the strain of work. The aim of the research was to find out whether there are correlations between subjectively perceived exertion and differences in cardioactivity even under mental load.

123 male and 56 female volunteers (47.6 ± 8.5 years old) participated in this study, but after consideration of exclusion factors and completeness of the database only 169 of them were finally used for the heart rate variability (HRV) and blood pressure analysis. Physiological tests during mental tasks under laboratory conditions were used. The subjectively perceived exertion for the three mental tasks is not correlated with the differences in cardioactivity.

HRV as a noninvasive tool for workload assessment in occupational medicine

Weippert, M., Kreuzfeld, S., Kumar, M., Arndt, D., Vilbrandt, R., Stoll, R.

Institut für Präventivmedizin der Universität Rostock

Interactions between human and automated systems in modern working environment produce mental strain. The estimation of operator's state is a problem in many fields like occupational medicine, adaptive automation and the design of man-machine-interfaces. Analysing heart rate (HR) and its variability (HRV) is useful for the assessment of operator's activation because mental strain is accompanied by dynamic changes in the autonomic nervous system.

Aim of this study was to map the relationship between subjective workload and objective physiological measures, using a non-linear, fuzzy based model.

Our subjects of investigation were 80 healthy men and women, aged 19 - 40 years, who performed different psychometric tasks (Vienna Testsystem® and Multitask®). In addition to primary and secondary task performance we assessed the subjective workload, using the NASA Task Load Index, and the physiological parameters HR and HRV of each trial. For analysing heart rate variability in time-frequency domain we used Continuous Wavelet Transform (CWT). For the modelling of the relationship between physiological measurements and subjective workload score we used Fuzzy-Logic-Techniques.

The developed model enables the estimation of subject's strain, based on the analysis of short time heart rate measurements.

It is a fact that changes in the frequency spectra, induced by mental stress, underlie a strong individuality. This is a main problem using HRV for mental workload assessment in practice. The reasons can be different physical fitness, age, gender, emotional state etc. The combination of HR- and HRV-analysis and fuzzy-logic techniques can cope with that problems and shows itself as an appropriate tool for subjective workload assessment.

Age-related effects on cognitive flexibility and cardiovascular activity among managers in steel industry

Schapkin, S. A., Freude, G., Erdmann, U., Ruediger, H.

Bundesanstalt für Arbeitsschutz und Arbeitsmedizin, Berlin

Managers have been confronting with complex and continuously changing tasks requiring cognitive flexibility and effort to maintain high performance during a long time period. These professionally critical functions may be investigated by the task-switching paradigm. Aging may negatively affect performance in switching tasks as well as compensatory mechanisms which maintain performance. German managers of a steel factory who were divided into younger (36-44 years) and elderly (47-60 years) groups, had to perform a task when they had to regularly switch between different rules of information processing or to use the same rule during task performance. Beat-to-beat systolic and diastolic blood pressure (SBP, DBP), heart rate (HR), heart rate variability (HRV), breathing frequency (BF) as well as performance measures were analysed. Although the performance did not differ between groups, the SBP and BF were higher in elderly. Cognitive load was accompanied by abrupt enhancing of BF and a reduction of HRV in younger group, while fast recovering of the parameters in post-hoc baseline was observed. In contrast, BF and HRV varied much smaller with experimental manipulations in elderly group. It is concluded that cardiovascular adaptation to task demands is less efficient among elderly managers.

Psychophysiological associations of noise in educational occupations - a 24-hour study

Seibt, R., Fischer, N., Scheuch, K.

Institut und Poliklinik für Arbeits- und Sozialmedizin,
Technische Universität Dresden

During a 24 hour measuring noise and its effects on heart rate as well as well-being were observed in educational occupations. Associations between these parameters were examined. The sample consisted of 41 pedagogues of five different educational fields (age: 36 ± 12 years). Workplace sound levels and heart rates were measured for 24 hours. Furthermore the well-being was assessed at four defined times. Under

working conditions an average equivalent sound level (L_{eq}) between 68 and 76 dB(A) was reached, whereas in leisure time these values were significantly ($p=.000$) lower (59-64 dB[A]). This difference was also measured in the average peak sound level in working time (100-107 dB[A]) and leisure time (95-101 dB[A]). The average equivalent sound level clearly exceeded the limiting values demanded in educational institutions (30-45 dB[A]). For the heart rate there was no significant difference between working (85-96 S/min) and leisure time (82-93 S/min). At night, the average heart rate varied from 65 to 71 S/min. For well-being a significant ($p=.000$) deterioration could be seen between values before and after working time as well as before sleep. Only a low correlation between sound levels and heart rate emerged. In summary, a sympathetic effect of noise on heart rate could not be verified.

Symposium 8: *Psychophysiological and Behavioural Correlates of Fear and Anxiety*

Gerdes, A. B. M., Wieser, M. J.
Lehrstuhl für Psychologie, University of Würzburg

In this symposium we present psychophysiological and behavioural data on mechanisms of fear acquisition, anticipatory anxiety, and how fear and anxiety may alter the early perceptual processing of affective stimuli. The first talk (Tabbert) examines whether conditioning-related amygdala activation and skin conductance responses depend on stimulus category, UCS probability and contingency awareness. The results show that these parameters influence amygdala activity and skin conductance response (SCR) differentially. This supports the idea of different levels of fear learning.

The second presentation (Melzig) employs heart rate variability as a trait marker to investigate emotional responding in a threatening context. Results indicate that low HRV is associated with increased anxious responding in anticipation of a shock. It is suggested that this physiological trait represents an impaired regulation of the defense system.

In the third talk (Gerdes), data from a binocular rivalry study on visual processing of phobic cues are presented. That perceptually ambiguous phobic cues predominate in spider-phobic patients indicates a preferential processing of phobic stimuli at early stages of visual processing.

The last talk (Wieser) presents data from a fear of public speaking paradigm, where ERPs were used to investigate the influence of anticipatory fear on processing of emotional facial expressions. The findings imply that experimentally induced fear of public speaking may modulate the intensity of early emotion processing.

Taken together, the symposium presents novel findings in research on fear and anxiety focusing on a variety of psychophysiological methods and experimental paradigms.

Effects of stimulus class and contingency awareness on skin conductance responses and neural activity during fear conditioning with varying UCS probabilities

Tabbert, K., Stark, R., Kirsch, P., Vaitl, D.

Abteilung Klinische Psychologie und Bender Institute of Neuroimaging,
Justus-Liebig-Universität Giessen

In differential fear conditioning usually one stimulus (CS+) predicts an aversive unconditioned stimulus (UCS), while another (CS-) does not. Previous studies showed an influence of contingency knowledge on conditioning related responses, while effects of objective UCS probability remain unclear. Therefore, in the present study a fear conditioning paradigm comprising four CS indicating 100% (CS+100), 66% (CS+66), 33% (CS+33), 0% (CS-) UCS probability was employed. Additionally, CS in two groups were either neutral faces or geometrical figures. Target region activations and skin conductance responses (SCRs) were analysed concerning stimulus class, UCS probability and contingency awareness according to a questionnaire.

Contingency awareness was equally distributed within the groups. Regarding neural activations main effects of awareness and of stimulus class emerged: Enhanced amygdala responses to the CS+ indicating higher UCS probabilities developed only in unaware participants. However, amygdala differentiation of CS+ > CS- was enhanced in the group receiving geometrical figures as CS. Conditioned skin conductance responses for all CS+ > CS- were found in aware but not in unaware participants regardless of stimulus class.

The present study thus confirms the idea of different levels of fear learning, with varying effects of contingency awareness, stimulus class, and UCS probability.

Decreased heart rate variability predicts increased anxious apprehension

Melzig, C. A., Thayer, J. F., Hamm, A. O.

Institut für Psychologie, Universität Greifswald

Heart rate variability (HRV) is emerging as an objective measure and trait marker of the ability to successfully regulate emotional responding. Two studies assessed anticipatory anxiety in a threatening context in groups of persons with low and high HRV. In study one 17 healthy participants were exposed to a safe and a prolonged anticipation of shock phase during which startle eyeblink responses to auditory startle probes, skin conductance level and heart rate were monitored. In a second study 37 students were exposed to 3 min safe and anticipation of shock phases that were indicated by different colored slides. Again, startle eyeblink responses, skin conductance level and heart rate were monitored. Participants of both studies were split into groups of low and high HRV according to their baseline HRV. In both studies persons with low HRV showed greater startle eyeblink potentiations during the threat as compared to the safe phase, indicating greater activation of the defensive system.

Group differences in threat-induced autonomic activation were also observed. Low HRV though proves to be a marker of increased anxious responding probably due to a decreased ability to successfully downregulate the response of the defense system.

An eye for spiders: Pictures of spiders predominate in spider phobic patients

Gerdes, A. B. M., Alpers, G. W., Pauli, P.

Lehrstuhl für Psychologie, University of Würzburg

When two incompatible pictures are presented to each eye and the brain cannot merge them to a meaningful percept this results in binocular rivalry: Temporarily one picture predominates conscious perception, while the other picture is suppressed. Recent studies have shown that emotional content promotes predominance.

To investigate whether individual differences in emotional responses to pictures results in differences in visual processing we presented phobic stimuli to phobic patients in binocular rivalry. Twenty three spider phobic patients and 20 non anxious control participants were presented standardized pictures of spiders and flowers, each paired with a neutral pattern. Their task was to indicate continuously the predominant percept by key press.

Spider phobic patients reported more often that spider pictures were their first percept and they indicated significantly longer durations of spider percepts than non anxious control participants.

Predominance of phobic cues in binocular rivalry provides further evidence for preferential processing of emotional pictures within the visual system.

Early perceptual processing of facial expressions is affected by fear of public speaking

Wieser, M. J., Mühlberger, A., Pauli, P.

Lehrstuhl für Psychologie, University of Würzburg

Fear is supposed to interfere with emotional processing and has been associated with an attentional bias for angry faces. In this study, the effect of anticipatory fear of public speaking on emotional processing was investigated. Participants were randomly assigned to one of two conditions. In the fear condition, actual fear of public speaking was induced by instructing the participants to perform an oral presentation on an unknown topic later during the experimental session which will be video-taped and evaluated by faculty members. In the control condition, the participants were told to have to do a brief written summary of arguments on an unknown topic. Participants then viewed angry, happy and neutral faces while EEG was continuously recorded. The fear-induction was successful as enlarged state anxiety scores for the experimental group revealed. Furthermore, higher fear was associated with larger P100 amplitudes in response to all facial expressions and shorter latencies for angry faces. The N170 was modulated by emotion display over the right hemisphere for the

fear group, whereas emotional modulation of EPN and LPP was only marginally affected by fear. The experimental results point at an influence of actual fear of public speaking on early perceptual processing of emotional facial expressions.

Symposium 9: *Neural Synchrony and High-Frequency Oscillations and its Relevance for Normal and Dysfunctional Cognitions*

Haenschel, C.

Labor für Neurophysiologie und Neuroimaging, Klinik für Psychiatrie, Frankfurt

Synchronous oscillatory activity of neural responses is a candidate mechanism for the coordination of neural activity between and within functionally specialized brain regions. The dynamic formation of such neuronal assemblies may range from local networks for early sensory processing to large-scale networks responsible for cognitive processes such as memory formation. In this symposium we will discuss recent evidence for the role of high-frequency oscillations in normal and dysfunctional cognitive processing.

In the first part we will present recent research investigating the relationship between neuronal synchronisation, object representation and memory processes both in the visual (T. Gruber) and the auditory modality (J. Kaiser) using EEG and MEG, respectively. The role of fast oscillatory synchronization for neuronal processes underlying higher cognitive functions will be discussed.

Recent models of cognition in schizophrenia have argued that many of the accompanying cognitive deficits may be explained by a deficient coordination of distributed brain activity. In the second part we (P. Uhlhaas, C. Haenschel) will discuss the relationship between neuronal synchronisation and dysfunctional cognitive processes in schizophrenia. These studies indicate a relationship between deficits in gestalt perception (P. Uhlhaas) as well as working memory (C. Haenschel) and reduced synchronisation in the beta- and gamma frequency range. Finally, the relationship between specific genetic polymorphisms implicated as risk factors for psychiatric disorders and gamma oscillations will be discussed (C. Herrmann).

Cortical object representations and memory processes: Insights from EEG Gamma-Band studies.

Gruber, T.

Institut für Psychologie, Universität Leipzig:

The activation of a cortical representation of an object is subserved by mechanisms that seem to rely on the activity of distributed neural assemblies coordinated by synchronous firing above 25Hz (so-called induced gamma-band responses; iGBRs). We investigated the question of how the morphology of these 'cortical object representations' is modulated by different mnemonic functions. In particular, we have conducted several EEG studies to examine iGBRs during implicit and explicit memory tasks. We found that (1) implicit memory for meaningful stimuli is achieved by the 'sharpening' of a cortical object representation, indicated by a decrease of iGBRs after the repeated stimulus presentation. In contrast, (2) the repetition of meaningless objects leads to iGBR increases indicating the 'formation' of a new representation. (3) The studies on explicit memory revealed that iGBRs are related to early familiarity-related retrieval processes (as defined within dual-process accounts of memory). Conclusively, iGBRs can be regarded as a signature of the automatic activation and formation of a 'memory trace' of a stimulus. Furthermore, the analysis of oscillatory brain activity provides a prominent informational gain as opposed to conventional ERPs (event-related potentials).

Oscillatory MEG activity and the dynamics of higher auditory processing

Kaiser, J.

Institute of Medical Psychology, J. W. Goethe-University, Frankfurt am Main, Germany

Fast cortical oscillations have been related to a multitude of cognitive processes including perception, attention, and memory. We have investigated gamma-band activity (GBA) in magnetoencephalogram (MEG) during different types of auditory processing. GBA increases were observed over higher sensory areas of the putative auditory ventral and dorsal streams during attentional processes as well as during maintenance of sound features in short-term memory. In addition, frontal GBA was found during different cognitively controlled processes. Recent studies have shown that the memorization of specific sound features like stimulus duration or lateralization angle during delayed matching-to-sample tasks was accompanied by distinct GBA components. The magnitude of these components during the delay phase contributed to the prediction of task performance. The resulting picture concerning the functional role of GBA goes beyond the traditional notion of a mechanism for sensory feature binding. Instead they suggest a more fundamental role of fast oscillatory synchronization for neuronal processes underlying higher cognitive functions.

Neural synchrony as a pathophysiological mechanism in schizophrenia

Uhlhaas, P. J., Rodriguez, E., Haenschel, C., Maurer, K., Singer, W.

Max-Planck-Institut für Hirnforschung, Frankfurt

In the current study, we explored the role of neural synchrony in the pathophysiology of schizophrenia by examining neural synchrony in schizophrenia patients (N=20), bipolar patients (N=15) and age-matched controls (N=20) as well as in a sample of children and adolescents (N=70). EEG-data were obtained during a Gestalt-perception task and analysed for induced and evoked spectral power as well as for phase-synchrony.

The results showed that: 1) patients with schizophrenia are characterized by a deficit in long-range synchronization in the beta- and theta-band. Dysfunctions in long-range synchronization were also present in bipolar patients but less pronounced than in schizophrenia. 2) patients with schizophrenia showed reductions in evoked beta- and induced gamma-band oscillations that were specific to patients with schizophrenia 3) evoked and induced high-frequency oscillations, especially in the gamma-band, strongly increased during adolescents. In addition, changes in the topography of phase-synchrony are indicative of widespread network reorganization during adolescence.

These data suggest that patients with schizophrenia are characterized by deficits in neural synchronization that may be related to cognitive deficits associated with the disorder. The pronounced changes of synchronous, oscillatory activity during adolescence suggest that aberrant maturation of cortical networks may be critically involved in the development of schizophrenia.

Dysfunctional beta- and gamma synchrony contributes to impairments in early-stage visual processing as well as maintenance in working memory in adolescents with schizophrenia

Haenschel, C.

Max-Planck-Institut für Hirnforschung , Frankfurt

Working memory (WM) deficits are a core feature of schizophrenia. There is recent evidence that both the encoding into WM and WM maintenance are dysfunctional. The aim of this study is to investigate the influence of impaired encoding on maintenance using time-frequency analysis. Fourteen patients diagnosed with early-onset schizophrenia according to DSM IV criteria and matched controls participated in a visual WM experiment. Subjects had to encode up to three abstract shapes that were presented sequentially for 600 ms each. After a delay of 12 seconds they had to compare the memorized shapes to a test shape, which was a match in fifty percent of the trials. 64-channel EEG was acquired at a 500Hz sampling rate.

The encoding and early maintenance period was analysed for both oscillatory activity as well as phase synchronisation. Patients showed reduced evoked beta and theta oscillatory activity. In contrast, induced gamma activity was higher for patients during WM load 1 and WM load 2 but smaller for the highest WM load condition compared to controls. In addition, patients showed reduced gamma phase synchrony compared to controls. These results show that deficits in WM occur both during encoding and during maintenance.

DRD4 and DAT1 polymorphisms modulate human EEG gamma band response

Herrmann, C. S.

Biologische Psychologie, Otto-von-Guericke-Universität, Magdeburg

Gamma oscillations (30-80 Hz) have been demonstrated to be important for perceptual and cognitive processes. Animal and in vitro studies have revealed possible underlying generation mechanisms of the gamma rhythm. However, little is known about the neurochemical modulation of these oscillations during human cognition. Schizophrenia and Attention Deficit Hyperactivity Disorder, which lead to failure of attentional modulation and working memory, introduce significant changes in gamma responses and have significant associations with genetic polymorphisms of the dopamine receptor D4 (DRD4), dopamine transporter (DAT), and catechol-O-methyltransferase (COMT). Therefore, the presence of direct relations between these polymorphisms and gamma oscillations was investigated in human subjects using an auditory target detection paradigm. The 7-repeat isoform of the DRD4 polymorphism that produces a subsensitive variant of the D4 receptor enhanced the auditory evoked and induced gamma responses to both standard and target stimuli. The 10/10 genotype of the DAT1 polymorphism, which reduces DAT expression and hence yields an increase in extracellular dopamine, specifically enhanced evoked gamma responses to target stimuli. The COMT polymorphism did not significantly change gamma responses. It seems plausible to assume that the modulation pattern of the evoked gamma response by DRD4 polymorphism relates to the regulation of the signal/noise ratio, whereas the DAT1 effect is related to the target detection mechanism.

Symposium 10: *The Aging Brain and Cognition*

Wild-Wall, N.

Leibniz Research Centre for Working Environment and Human Factors (IfADo),
Dortmund

The presentations in this symposium will be focussing on changes in cognition as a consequence of healthy and pathological aging and their neural basis. The first talk will highlight the role of the mid-brain dopamine system for error processing in a group of patients with Parkinson's disease and age-matched older controls. The dopamine system is also part of a reward learning network where changes are observed in healthy aging as well. The second talk will focus on error-monitoring in stimulus-response learning during aging. The third talk will extend this topic by showing that brain potentials which are related to negative feedback processing differ between old vs. young participants. Memory and especially prospective memory is another aspect of cognition which has been shown to be age-sensitive. The last talk takes a life-long perspective on changes in prospective memory function by discussing the neural basis of different age-related performance patterns.

Error processing in Parkinson's disease

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¹Leibniz Research Centre for Working Environment and Human Factors (IfADo)

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The hallmark of Parkinson's disease (PD) is a depletion of dopamine. Error processing, as reflected in a component of the event-related potential, the so-called error (related) negativity (Ne or ERN) is likely dependent on the midbrain dopaminergic system. In case of an unfavourable event such as an errors this system is assumed to send an error signal to the mediofrontal cortex, which elicits the Ne. Hence the Ne should be altered in patients with PD. In fact we earlier found a reduction of the Ne in medicated patients with PD after errors committed in different tasks (Falkenstein et al. 2001), while another group (Holroyd et al 2002) found no such reduction in patients off medication in a flanker task. In the present study we re-investigated this issue by measuring the Ne in a large group of medicated PD patients on and off L-DOPA medication compared to matched control subjects in a flanker task. The Ne was found to be unchanged between the on and off states, while the motor symptoms were affected. In both medication states the Ne was smaller in the patients than in the controls. The results show that the Ne reduction found earlier is unaffected by short-term differences in DOPA medication. The question remains open whether the long-term DOPA medication could have affected the Ne.

Changes of response monitoring with learning: differences between older and younger adults

Pietschmann, M., Endrass, T., Kathmann, N.

Humboldt-University Berlin

The comparison of actions and their outcomes with internal goals, termed response monitoring, is essential for goal-directed and adaptive behavior. The question whether response monitoring functions decrease with age has not yet been answered comprehensively. Response monitoring can be studied using the error-related and the correct response negativity (Ne or ERN and CRN), two components of the event-related brain potential following incorrect and correct responses. This study examined changes in response monitoring during learning, and whether older adults differ in these processes.

The EEG was recorded at the beginning of an association-learning task and after completed learning. The results showed similar-sized ERN and CRN amplitudes at the beginning of the learning process in both age groups. With advanced learning, response monitoring became error-specific in younger adults, reflected by decreased CRN and increased ERN amplitudes. This dissociation was observed in older adults only in later task phases, suggesting that older adults need longer practice periods to develop error-specific response monitoring.

Adult age differences in reinforcement learning

Kray, J., Eppinger, B., Mock, B., Mecklinger, A.

Saarland University

The aim of our study was to examine age differences in reinforcement learning by means of electrophysiological correlates of error processing, the error-related negativity (Ne or ERN) and the feedback-related negativity (FRN). We applied a probabilistic learning task in which subjects had to infer stimulus-response assignments by trial and error depending on positive and negative feedback. Results of our study showed that learning-related changes were more pronounced (a) in a response-locked positivity for correct trials than in the ERN and (b) in a feedback-locked positivity for positive feedback than in the FRN. In contrast to learning models that assume that learning is primarily driven by errors and negative feedback (e.g., Holroyd & Coles, 2002), these results suggest that learning is also driven by correct responses and positive feedback. Moreover, when controlling for performance differences between age groups, the ERN did not differ between younger and older adults throughout learning, suggesting that error processing is not impaired in the elderly. In contrast, compared to younger adults, the FRN was substantially reduced in older adults, indicating that the elderly are less affected by negative feedback and may rely more on positive feedback.

Neural correlates of intention formation and intention execution: A lifespan perspective

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Research in the developmental domain of prospective memory suggests a lower prospective memory performance in childhood and old age compared to young adulthood. These age groups have never been compared directly, hence it is unclear whether the factors explaining prospective remembering are identical in these groups and if the neural correlates recruited for successful prospective remembering are changing during development. Behavioural results revealed the expected inverted U-shaped function with young adults having the best prospective memory performance. Analyses of error data, however, imply that different processes may have contributed to failures of prospective memory in adolescents and old adults. Whereas the poorer performance of old adults seems to be a result of difficulties in encoding of intentions and self-initiated retrieval of prospective cues, adolescents tend to forget the content of the intention. This effect of age on prospective memory performance is supported by age-related differences in ERP-components for intention encoding, cue detection, and post-retrieval monitoring processes. Source localizations of these ERP-data with LORETA revealed different activation patterns for adolescents and old adults. Overall, our findings suggest that adolescents and old adults show different kinds of error patterns in prospective memory tasks and recruit different neural generators for successful prospective remembering.

Symposium 11: *Electrophysiological Correlates of Negative Priming*

Gibbons, H., Frings, C.

Institut für Psychologie, Universität Göttingen

Negative Priming (NP) refers to increased RT when responding to a target that previously served as distractor, compared to unrepeated targets. There is a long-lasting debate whether NP reflects persisting inhibition of the prime distractor or retrieval of a do-not-respond tag encoded with the prime distractor. Event-related potentials (ERPs) may be used to further elucidate the experimental locus of NP. On the present symposium, six studies on ERP correlates of NP are presented, providing evidence for both inhibition and retrieval processes. In particular, Mayr, Gibbons and Stahl, and Behrendt et al. observed effects which are interpreted as correlates of retrieval processes. Mayr employs the lateralized readiness potential (LRP) and confirmed specific predictions derived from prime-response retrieval theory, regarding the dependence of LRP pre-activations on prime-probe hand shift. Gibbons and Stahl observe reduced P300 amplitude and earlier LRP onset to accompany flanker NP, indicating persisting activation and increased motor processing time, respectively, thus challenging inhibition view. Behrendt et al. report on reduced late frontal positivity specific to the NP condition which suggests prolonged coordinative processing effort required for the solution of response conflict. In contrast, ERPs obtained by Kehrer et al., Hauke, and Frings and Groh-Bordin are in line with an inhibition account of NP. Kehrer et al., found NP in an easy selection task while in a difficult selection task ERPs suggest increased attentional effort counteracting sensory inhibition. Hauke shows that auditory identity-based NP depends on the number of prime distractors; the same holds for amplitude reductions of N1 and P300 components. Both persisting inhibition and episodic retrieval are suggested to contribute to NP. Frings and Groh-Bordin observed an N200 modulation specific to the NP condition irrespective of whether probe distractors were presented, thereby defending inhibition accounts. Overall, the presented electrophysiological results specify inhibition and retrieval processes underlying NP.

LRP effects of negative priming: Tests of the prime-response retrieval theory

Mayr, S.

Heinrich-Heine-Universität Düsseldorf

In accordance with the episodic retrieval model of negative priming the probe target in ignored repetition trials cues the retrieval of the prime episode including some kind of non-response information to the former prime distractor. A new variant of this model, the prime-response retrieval model, assumes that retrieval of the prime response causes the interference in responding to the probe target. Lateralized readiness potentials (LRPs) as indicators of response hand preparation can be used to test a unique prediction that can be inferred from the prime-response retrieval model: If prime responses are cued by the probe target in ignored repetition trials and if the prime and probe response have to be executed by opposite hands, wrong response hand preparation should be found in ignored repetition trials. This prediction was tested in a number of auditory categorization and identification experiments that will be reported. Overall, evidence of prime response retrieval was found, however, effects were rather small.

Event-related potential correlates of flanker negative priming

Gibbons, H., Stahl, J.

Institut für Psychologie, Universität Göttingen

Event-related potential (ERP) correlates of flanker negative priming (NP) were investigated. 36 participants responded to the central digit (“target”; T) of a triplet of digits and ignored the flankers (“distractors”; D). The DT condition employed the preceding distractor as the target and produced NP in terms of a 13-ms RT increase compared to a control condition where no stimuli were repeated. Repeating the target stimulus (TT condition) produced an 81-ms positive priming (PP) effect. In ERPs, left-posterior P300 amplitude was reduced for both conditions TT and DT, indicating persisting activation also in the DT condition. Thus, P300 findings are better in line with episodic-retrieval than activation/inhibition explanations of flanker PP and NP, since the latter approach predicts larger P300 for the DT condition. P300 reduction may correspond to the perception of both TT and DT displays as similar to the preceding display, probably causing retrieval of the preceding response. While this response is correct in the TT condition, it is wrong in the DT condition, inducing response conflict. A response-conflict account of flanker NP also receives support from the fact that onset of the response-locked lateralized readiness potential occurred significantly earlier for DT than control, suggesting increased motor processing time.

Event-related brain potential correlates of semantic negative priming

Behrendt, J.^{1,2}, Gibbons, H.⁴, Schrobsdorff, H.^{1,3}, Ihrke, M.¹, Herrmann, M.^{1,3}, Hasselhorn, M.²

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² Section for Educational and Developmental Psychology,

³ Institute for Nonlinear Dynamics

⁴ Section for Biological Psychology,

In our study event-related potentials and behavioural measures were obtained from 16 participants while they performed an identity-based priming task, in which objects have to be named aloud. The shown displays have been designed from superimposed line-drawings of seven green target- and red distractor-objects. Several priming conditions were realized in a balanced mix of control- (CO), negative-priming- (NP), positive-priming- (PP) and single-target-trials (ST). All relevant RT-differences for PP- and NP- relative to CO-trials were significant. For both PP and NP, smaller P300 amplitude was observed, reflecting reduced effort with stimulus identification (or, persisting activation) whenever the probe target was a repeated prime stimulus. This finding challenges persisting-inhibition explanations of semantic NP. Secondly, amplitude of a fronto-polar late positive complex (LPC) increased in the order NP, CO, and PP. Moreover, this component peaked earlier for PP trials. Priming therefore seems to affect brain activity related to the coordination of cognitive and motor processing. Reduced LPC amplitude for NP may indicate less rigorous and/or delayed updating of coordinative processing resources and is therefore well in line with an episodic-retrieval view which attributes NP to a late processing conflict.

Sensory visual conflicts can be reduced by adaptive attention mechanisms

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Recent studies provide evidence that attentional resources are focused on task-relevant stimuli to resolve conflicts from distracting events (Weissman 2004). We hypothesize that more difficult target selection conditions lead to stronger attentional top-down control reducing the effects of arising conflicts. The role of these mechanisms on the location negative priming (NP) effect was investigated with event-related potentials (ERP). A significantly delayed reaction time (RT) for NP- as compared to control-trials was only evident in the easy task. However, ERP analysis revealed a reduced N1-amplitude of NP-trials compared to control-trials, both in the easy and the difficult task. In contradistinction, significantly delayed P3-latency was

found for NP-trials only in the easy task. We suggest that the RT and N1-effect for NP-trials in the easy task reflect an inhibitory mechanism, modulating early sensory processing associated with a slowing of stimulus evaluation. Since the NP-effect was found in the difficult task for the N1-amplitude but not in the RT, we assume that early sensory inhibition occurs also in the difficult task. However, the P3-latency results indicate that additional attention mechanisms are involved in processing of the complex task, suggesting that the early NP-effect is abolished at a later stimulus evaluation stage

EKP correlates of negative priming and distractor repetition

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An auditory identification task and event-related brain potentials (ERPs) were used to investigate the correlates of negative priming and distractor repetition. The probe presentation was preceded by either one or three identical prime distractor presentations. An enhanced negative priming effect was found after three distractor repetitions in the reaction times and error frequencies. In the ERPs a more negative-going P3 amplitude was found as a correlate of negative priming. This correlate was not modulated by the number of distractor repetitions. It was interpreted as evidence for the episodic retrieval model. The analysis of the N1 amplitude showed an interaction between negative priming and distractor repetition. The N1 amplitude was reduced in the ignored repetition-condition after three distractor repetitions. This effect was interpreted as a correlate of inhibitory mechanisms and was thus consistent with the distractor inhibition model. A combination of the distractor inhibition and the episodic retrieval models is needed to account for the reported results.

Does visual identity negative priming hinge on the presence of probe distractors? Evidence from electrophysiological and behavioural measures

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Negative priming (NP) refers to the finding that reactions to stimuli which were presented as distractors in the prime display and are then repeated as targets in the probe display, are slower and more error-prone than reactions in trials without repeated stimuli. However, there is a long-lasting debate about the observation that NP hinges on the presence of distractor stimuli in the probe display. The two most prominent theories of NP, namely the inhibition and the episodic retrieval account, offer different explanations for this observation. While it flows easily from an episodic retrieval account, inhibition theory has to make several additional assumptions to explain this dependence of NP on the presence of probe distractors. In two

experiments, we analyzed event-related potentials (ERPs) to shed light on this issue. When probe distractors were present, we found significant NP in reaction times along with an ERP component (N200) that was specifically enhanced in the NP condition. In contrast, when probe distractors were absent, no NP in reaction times emerged, but preliminary data analyzes still show the N200 to be enhanced in the NP condition. Hence, although being at work, reaction times may not be sensitive enough to measure NP without probe distractors.

Negative semantic priming effects come along with inversed N400 effects

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Within the semantic priming paradigm, participants have to react to a target word that was preceded by a prime word. Usually, reactions to targets are facilitated if prime and target are semantically related (e.g., prime: flower; target: rose) compared to unrelated prime-target pairs (e.g., prime: bird; target: rose). With a special presentation technique (see Wentura & Frings, 2005, JEP:LMC), this effect can be inversed so that longer reaction times occur after related compared to unrelated targets. This technique degrades the representation and processing of the prime by repeatedly heckling the prime presentation by a consonant letter string. An EEG study (n = 32) replicates the behavioral findings of negative semantic priming effects and shows the most interesting ERP effect in the N400 time window. Here, there is a stronger negativity for related compared to unrelated targets. This effect corresponds with the negative behavioral effect and is opposed to the classical N400 effect from clearly visible primes where the stronger negativity follows the unrelated targets. The results can be explained with a centre-surround inhibition mechanism and sheds further light on possible processes which modulate the N400 component.

Probing the nature of semantics: ERPs to proverbs

Kotchoubey, B., Jander, M.

Universität Tübingen

There are different interpretations of the semantic processing as manifested in the ERP wave N400. According to one view, semantic context automatically activates related nodes in a network. The more context-relevant is a presented word, the stronger it has been pre-activated by the context, the less additional activation is necessary, the smaller the N400 amplitude. Another account regards the N400 as a manifestation of the effort required to integrate the word into the context. The stronger the word-context relationship, the less resources are needed for semantic integration, the smaller the N400 amplitude. Although apparently similar, the two accounts lead to opposite predictions in a simple proverb experiment. Participants were presented well known proverbs, with their end words being either completely

correct or completely wrong and absurd. Participants' task was simply to distinguish correct from incorrect proverbs. From the viewpoint of automatic activation, the N400 to wrong endings would be particularly large due to the very strong context priming of the correct endings. To the contrary, from the viewpoint of semantic integration the N400 would be reduced, because semantic integration of the absurd endings was neither required nor possible. The data support the latter view: a smaller than usual N400 was recorded to wrong proverbs, accompanied by a large parietal P600.

Symposium 12: *Psychobiology of Cardiovascular Risk*

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General summary:

In spite of numerous efforts to improve cardiovascular morbidity and mortality, e.g. by lifestyle or pharmacological interventions, cardiovascular diseases continue to be the principle cause of death in western countries. A growing body of research suggests that psychological factors, including chronic stress and depression, are involved in the development and progression of cardiovascular diseases. It is therefore an important aim within the field of psychobiology to identify psychological factors involved in the pathophysiology of cardiovascular conditions and to assess the mechanisms underlying interactions between the psyche and physiological parameters associated with cardiovascular risk in at-risk populations as well as in healthy subjects.

In the proposed symposium, we present new data addressing interactions between psychological factors, particularly psychological stress and depression, and cardiovascular responses in individuals with cardiovascular conditions, including patients with hypertension (abstract 1), and venous thromboembolic disease (abstract 2), patients who are at risk due to obesity and insulin resistance, i.e., women with the polycystic ovary syndrome (abstract 3), and healthy subjects, i.e., older marathon runners (abstract 4). With respect to the measured parameters, the symposium particularly focuses on intermediate risk factors for cardiovascular diseases including blood lipids, inflammatory markers, coagulation activity and psychological stress reactivity.

Given the wide range of study populations on the one hand, and differing experimental approaches on the other hand, the proposed symposium gives an overview of the wide range of implications and research strategies in this emerging interdisciplinary field.

Changes in plasma lipids with psychosocial stress are related to hypertension status and the norepinephrine stress response

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Background: Hypertensive individuals show exaggerated stress reactivity of norepinephrine, which in turn can induce lipolysis to result in increased levels of free fatty acids in the circulation. We investigated whether resting blood pressure and acute stress-induced norepinephrine increase are associated with stress-induced lipid changes corrected for stress-hemoconcentration in men with normal and elevated blood pressure.

Methods: Twenty-two unmedicated hypertensive (systolic and/or diastolic BP $\geq 140/90$ mmHg) and 23 normotensive men (mean \pm SEM: 45 ± 3 years) underwent a 15-min standardized psychosocial stress task. We measured plasma norepinephrine and the plasma lipid profile [total cholesterol (TC), low density lipoprotein (LDL)-C, high density lipoprotein (HDL)-C, and triglycerides (TG)] immediately before and after stress and during 60 min of recovery. All lipid levels were corrected for stress-hemoconcentration.

Results: Mean arterial pressure (MAP) predicted immediate stress changes in TC ($\beta=.36, p=0.016$), TG ($\beta=.33, p=0.040$), and LDL-C ($\beta=.26, p<.08$). Immediate increase in norepinephrine release independently predicted immediate stress change in TC ($\beta=.34, p=0.021$) and LDL-C ($\beta=.36, p=.012$). The integrated norepinephrine stress reactivity from rest to recovery predicted integrated changes in TC ($\beta=.40, p=.015$) and LDL-C ($\beta=.39, p=0.016$), although not independently of age and body mass index. The MAP-by-norepinephrine interaction independently predicted immediate stress change of HDL-C ($\beta=-.58, p<.001$) and with borderline significance of LDL-C ($\beta=-.25, p<.08$).

Conclusion: Resting BP, norepinephrine stress reactivity and their interaction affect proatherogenic changes of plasma lipids in response to acute psychosocial stress suggesting one mechanism by which stress might trigger acute cardiac events in hypertension.

Depressive symptoms predict plasma D-dimer levels in patients with venous thromboembolic disease: Buffering effect of social support

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Background: Plasma D-dimer levels indicating fibrin formation and degradation are associated with increased risk of recurrent venous thrombotic events in patients with venous thromboembolism (VTE). Whether psychosocial factors contribute to the risk of VTE has not been investigated. We hypothesized that depression would be associated with D-dimer levels in patients with spontaneous VTE. Following the theory that social ties may act as stress buffers, we further hypothesized that this association would be affected by social support.

Methods: Study participants were 65 consecutive patients (51% men; mean age 45±13 years; mean body mass index (BMI) 26±5 kg/m²) who underwent thrombophilia work-up because of objectively diagnosed spontaneous VTE (e.g. deep venous thrombosis of the lower limb, pulmonary embolism). Patients with a permanent risk factor for VTE (e.g. cancer) were excluded from this study. Depressed mood was rated by the Hospital Anxiety and Depression Scale (HADS) and social support by the Enhancing Recovery in Coronary Heart Disease (ENRICHD) Social Support Instrument. Plasma D-dimer levels were determined by the Vidas D-dimer rapid ELISA test.

Results: Hierarchical regression analysis controlling for age, gender, and BMI rendered the interaction between depression and social support as a significant predictor of plasma D-dimer levels ($p=0.017$). Post hoc regression analyses applying the Holmbeck method indicated that the relationship between depression and D-dimer was significant in patients with low social support ($\beta=0.40$, $p=0.006$, $\Delta R^2=0.78$) but not in patients with high social support ($p=0.29$). Additional controlling for current oral anticoagulant therapy did not change these results.

Conclusions: Depression independently predicted plasma D-dimer levels in patients with spontaneous VTE who were low in social support providing first evidence for a mechanism by which psychosocial factors may contribute to the risk of recurrent VTE.

The role of depression in the association between obesity and immune dysregulation in polycystic ovary syndrome.

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Background: Many women with the polycystic ovary syndrome (PCOS) are obese, and suffer from the metabolic syndrome at a relatively young age, increasing their risks for cardiovascular diseases and diabetes mellitus T2. Depression is also common in PCOS. Obesity plays a role in immune dysregulation in PCOS, but the contribution of depression remains unclear. We addressed the contribution of depression to the association between obesity and chronic low-grade inflammation and disturbed stress responsiveness in PCOS.

Methods: In N=30 women with PCOS, body mass index (BMI), serum IL-6, hsCRP, HDL, and leukocytes were assessed, together with Beck Depression Inventory (BDI) scores. Correlational and regression analyses with BMI and BDI as predictors were carried out. In addition, the neuroendocrine and immune cell responses to public speaking stress were compared in PCOS with and without symptoms of depression (BDI score < 11 vs. BDI score ≥ 11).

Results: Basal levels of IL-6 ($r = .67$, $p < .001$), hsCRP ($r = .81$, $p < .001$), HDL ($r = .48$, $p < .01$), heart rate ($r = .47$, $p < .01$) and leukocytes ($r = .41$, $p < .05$) were significantly correlated with BMI, but not with depression scores. Whereas depression was not a significant predictor in regression models, BMI explained a significant and considerable amount of variance (for IL-6: 47 %, hsCRP: 66 %, WBC: 16 %). In response to public speaking stress, patients with depression demonstrated increased state anxiety and natural killer cells (group effects: $p < .05$), irrespective of BMI.

Conclusion: In PCOS, depressive symptoms do not appear relevant for chronic low-grade inflammation, which is primarily explained by obesity. However, depression affects responses to acute psychological stressors. Together, obesity and disturbed stress responsiveness may contribute to the long-term cardiovascular risks associated with the diagnosis.

Paper Session 1: Sleep

Chair(s): Born, J.

Arousability from REM sleep

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The study addresses the sequencing of nocturnal sleep stages and the functional significance of sleep architecture. One important feature that the rationale of most theories on sleep architecture rests upon concerns the arousability from rapid eye movement (REM) sleep. The most prominent traditional view is reflected in the “sentinel hypothesis” which proposes that REM sleep follows NonREM sleep because it serves a preparatory function for the wake state. Contrary to this approach, the “protective fields model” focuses on the formal aspects of sleep structure and suggests that REM sleep in general and phasic REM sleep in particular is a state of heightened internal neuronal activity and lowered responsivity to external stimuli. Empirical evidence is contradictory, showing lower as well as higher arousal thresholds to auditory stimulation. Possibly, the conflicting evidence is due to the failure to distinguish between phasic and tonic REM sleep episodes. The current study reports on arousal thresholds and frequency band activity in response to auditory stimuli presented during NonREM stages 2 – 4 and phasic and tonic REM sleep. Results generally support the protective fields model but also point to individual differences in response patterns.

Sleep reorganizes declarative memories from hippocampal towards cortical storing sites

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Declarative memory consolidation is supposed to rely on a time-dependent process that gradually incorporates recently acquired hippocampal memory traces into cortical long-term knowledge structures. We show that sleep facilitates these representational changes. Post-learning sleep as compared with wakefulness made memories less dependent on the hippocampus while cortical areas became significantly more engaged. From additional behavioral data we conclude that this sleep-dependent reorganization renders initially vulnerable memory traces increasingly resistant against interference. Circadian variations and influences of sleep deprivation were ruled out as possible confounds. Our results indicate that sleep consolidates declarative memories by reorganizing them from hippocampal towards cortical storing sites.

Selective serotonin or norepinephrine reuptake inhibitors do not impair memory consolidation during sleep

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Selective serotonin (SSRI) or norepinephrine (SNRI) reuptake inhibitors are widely used to treat psychiatric disorders like depression and consistently reduce the amount of REM sleep. However, REM sleep is believed to have beneficial effects on memory consolidation especially with regard to the development of procedural skills. In the present study we investigated whether acute SSRI or SNRI administration impairs memory consolidation during sleep. Healthy young men learned a procedural memory task (mirror tracing), a declarative memory task (word-pair associates) and an olfactory memory task before sleep. In one night, they received either the SSRI fluvoxamine (50 mg orally) or the SNRI reboxetine (2 mg orally) immediately after learning. In the other night they received a placebo according to a double-blind cross-over design. Retrieval was tested 36 hours later. Both treatments significantly reduced the amount of REM sleep. However, memory retention in the procedural and declarative memory tasks remained unaffected. Moreover, olfactory recognition memory was even enhanced after inhibiting reuptake of norepinephrine, but not serotonin. Our results suggest that acute administration of SSRIs and SNRIs has no negative impact on memory consolidation during sleep.

Sleep transforms the cerebral trace of declarative memories

Gais, S., Albouy, G., Boly, M., Dang-Vu, T. T., Darsaud, A., Desseilles, M., Rauchs, G., Schabus, M., Sterpenich, V., Vandewalle, G., Maquet, P., Peigneux, P.

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After encoding, memory traces are initially fragile and have to be reinforced to become permanent. The initial steps of this process occur at a cellular level within minutes or hours. Besides this rapid synaptic consolidation, systems consolidation occurs within a time frame of days to years. For semantic memory, the latter is presumed to rely on an interaction between different brain regions, in particular the hippocampus and the medial prefrontal cortex (mPFC). Specifically, sleep has been proposed to provide a setting which supports such systems consolidation processes, leading to a transfer and perhaps transformation of memories. Using functional magnetic resonance imaging (fMRI), we show that post-learning sleep enhances hippocampal responses during recall of word pairs 48 h later, indicating intrahippocampal memory processing during sleep. At the same time, sleep induces a memory-related functional connectivity between the hippocampus and the mPFC. Six months after learning, memories activate the mPFC more strongly when they were encoded before sleep, showing that sleep leads to long-lasting changes in the representation of memories on a systems level.

Sleep slow oscillations are increased by carbamazepine

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The cortical slow oscillation with its 'up' and 'down' states has been implicated in the sleep-associated consolidation of memories. While during the depolarizing up state neuronal firing can exceed rates during waking, the down state is characterized by hyperpolarization of the neuronal membrane potential and reflects a cessation of excitatory input. In the present study the effect of a reduction in cortical excitability on EEG activity including the slow oscillation was investigated. On 1 of 2 experimental sessions 13 human subjects received an oral dose of either the anticonvulsant carbamazepine or placebo at 21:00 h; at 23:00 h subjects were permitted to sleep. EEG power within the slow oscillation, delta, theta, slow spindle, fast spindle and beta bands was analyzed for the first 3 hours after sleep onset. The amount of time spent in the sleep stages S1-4, REM sleep did not differ between conditions. However, within SWS carbamazepine increased both slow oscillation (0.5-1 Hz) and slow spindle (8-12 Hz) EEG power ($p < 0.05$). It is tentatively concluded that the level of cortical excitability and more specifically the putative tonic suppression of voltage-dependent cation channel activity (Na^+ , Ca^{2+}) is beneficial for the occurrence of the slow sleep oscillation.

Paper Session 2: *Visual Processing I*

Chair(s): Busch, N. A.

Event-related potentials and gamma-band activity reveal different qualities of change-detection and change-blindness

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In change-blindness research, it is currently debated whether changes can be sensed preattentively without a corresponding visual experience. While some authors have claimed that sensing and visual experience are separate processes, others hold that there is merely a quantitative difference. We investigated qualitative and quantitative electrophysiological differences between sensing and visual experience. On each trial, an array of coloured objects was presented for 615 ms, replaced by a blank screen for 80 ms, and presented again for 615 ms. One object was changed in the second display on half of the trials. Participants reported whether or not they detected any change, irrespective of whether or not they could report the object's identity. On correctly detected change trials, participants were additionally asked for the object's identity. While detection requires only sensing, identification requires a visual experience of the change. Effects of both change detection and identification were found on induced gamma-band activity and on a negative posterior ERP component at a und 200 ms. In contrast, only identification was associated with an N2PC contralateral to the side of a change. This qualitative electrophysiological difference between change detection and identification supports the claim that sensing and visual experience are indeed different perceptual qualities.

Attentional selection of features, feature-conjunctions and space

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In a series of experiments we examined feature-based attentional selection and its relation to spatial attention. The steady-state visual evoked potential (SSVEP), a continuous measure of selective stimulus processing, was recorded. Our results show that (1) an attentional selection of color, not mediated by spatial selection, is possible, (2) color-based selection also affects spatially unattended positions and the effects of color-based and spatial attentional selection are combined in a largely additive manner and (3) two non-spatial features (i.e. color and orientation) can concurrently be selected and the attentional effects of such selection are also combined in a largely additive manner.

Our results are in good accordance with the feature similarity gain model and confirm predictions of this model. The concurrent selection of two non-spatial features observed in the last experiment provides a neurophysiological basis for the rapid

identification of feature conjunctions during visual search, as proposed by the guided search model.

Task matters: instruction impact on human gamma band activity

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Gamma-band activity in human EEG has been suggested to play a crucial role in integrating distributed neural responses and is, moreover, thought to be a neural marker of a cortical object representation.

Although this interpretation is supported by a large number of investigations, several studies have been published that do not fit with this view. One reason for this diverging findings can be seen in different experimental designs.

An outstanding question on the role of induced gamma activity focuses on the extent to which its elicitation is task-dependent.

So far, there is a lack of direct comparisons of the impact of task requirements (e.g. detection vs. discrimination task, speeded vs. delayed responses) on gamma responses in the literature.

We present here a systematic comparison of different experimental paradigms with varying task requirements and the corresponding finding concerning induced gamma band activity.

Our findings show that the topographical distribution as well as the latency of these responses varies considerably with task requirements. This is of high significance, because the findings indicate that gamma band responses are not merely elicited by the presence of a visual stimulus. Instead, gamma responses might play a crucial role in postperceptual processing most likely reflecting feedback from higher areas.

A functional network associated with visual deviance

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A stimulus-change detection mechanism operates by comparing new sensory input with memory traces of previous input, even in the absence of conscious awareness or directed attention. On the comparison of an unexpectedly changed stimulus a signal is generated reflecting the detection of a violation of regularities in stimulation. This phenomenon is known as mismatch. Detection of change can trigger an attention switch, enabling a rapid preparation and execution of a response to this unexpected event. To investigate the functional network involved in unintentional visual change detection an experiment known to induce electrophysiological mismatch was implemented in an fMRI study.

Preliminary MRI analyses of change induced activation revealed activity in occipital areas, the right frontal area, the premotor cortices, and thalamus. A deactivation was found in the cingulate area.

It is plausible to assume that these regions are associated with the different processes underlying change detection, like comparison of the new incoming information with a memory trace holding previously received information or the detection of conflict between these two sources of information.

Paper Session 3: Stress

Chair(s): Mussgay, L.

Heart rate variability biofeedback in blood pressure reduction: The mediating role of baroreflex-sensitivity

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The study investigates the effects of heart rate variability (HRV) biofeedback (EG), compared to an attention placebo control (CG), as a treatment for essential hypertension. All subjects met the criteria for Stage 1 hypertension (140-159/90-99 mmHg). Patients were assigned randomly. Both groups received 10 training sessions. During the 1st, 5th, 10th session, and at follow-up (3 month), blood pressure, HRV, and baroreflex-sensitivity (BRS) were collected. During hospital treatment as well as during the follow-up period, both patient groups were asked to practice daily using the acquired intervention method. Biofeedback was administered to both groups in addition to the standard treatment of the hospital.

36 complete data sets were available (18 in each group of 31 EG and 29 CG patients). Relative to a 24-h blood pressure measurement the EG showed stronger initial decreases in blood pressure, compared to CG. In the further course of the study, however, these reductions subside until in the end, no group differences remain. BRS and HRV in the EG increased markedly during the initial training phase. BRS changes seem to be related to blood pressure reductions. However, subsequent adaptation processes obviously counteract this initial gain. Patients of the EG could substantially reduce the intake of antihypertensive medication.

The glucocorticoid receptor gene exon 1-F promoter is not methylated at the NGFI-A binding site in human hippocampus

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Recent research has demonstrated that early life experience, such as variation in maternal care, can have a profound impact on the physiological and endocrine stress response of *Rattus norvegicus*. Low maternal care resulted in increased methylation of the nerve growth factor-inducible protein A (NGFI-A, EGR1) binding site located in the hippocampal glucocorticoid receptor gene (*Nr3c1*) exon 1-7 promoter, leading to decreased *Nr3c1* expression, which results in a reduced efficiency of glucocorticoid-mediated negative feedback on hypothalamus-pituitary-adrenal axis activity. The human glucocorticoid receptor gene (*Nr3c1*) has a highly similar 5' structure compared to the rat, and the human alternative exon 1-F is the orthologue to the rat exon 1-7. Based upon the evidence from rats, and the high sequence identity of the regulatory sequences, we examined the methylation pattern of the corresponding

NGFI-A binding site in the human glucocorticoid receptor exon 1-F specific promoter in post-mortem hippocampal tissue.

In contrast to the findings in rats, neither of the two CpG motifs within the NGFI-A binding site was methylated in the 32 subjects investigated. These observations might reflect different promoter methylation patterns in humans and rats.

S-Citalopram and Citalopram in neuroendocrine challenge tests – effects of basal HPA activity

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Neuroendocrine Challenge test have been used widely as an index of central serotonergic activity. However, a major point of criticism has been the lack of specificity of many probes used. The selective serotonin reuptake inhibitor (SSRI) S-Citalopram is the most specific SSRI available. S-Citalopram is the active enantiomere of the racemic mixture Citalopram, which has been employed as a serotonergic probe in several newer studies. Recently we showed that S-Citalopram induces a reliable dose dependent cortisol increase in healthy subjects, underlining its usefulness as a neuroendocrine probe. We conducted a follow up study in 24 healthy men, using Citalopram and S-Citalopram in a double blind, placebo controlled crossover design, further analysing the appropriateness of S-Citalopram as serotonergic probe. The potential effects of basal HPA activity, as indicated by measures of the cortisol-awakening-response (CAR), on placebo corrected cortisol release after Citalopram (20 mg) and S-Citalopram (10 mg) were tested. Furthermore, effects of body mass index and lean body mass are analysed. Results are discussed with regard to the further use of S-Citalopram as a neuroendocrine probe, in the light of recent critical findings in the literature.

Lack of cortisol response in persons with severe PTSD undergoing a diagnostic interview

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This study investigated the cortisol response in traumatized male refugees with severe posttraumatic stress disorder (PTSD) during a detailed and standardized interview about their personal war and torture experiences. 17 participants were administered the Vivo Checklist of War, Detention, and Torture Events, a standardized interview about traumatic experiences, and 16 participants were interviewed about absorption behavior (as a non-stressful control condition). Self-reported measures of affect and arousal as well as saliva cortisol were collected at four points. Before and after the experimental intervention, subjects performed the Delayed Matching-to-Sample (DMS) task for distraction. They also rated the severity

of selected PTSD symptoms as well as the level of intrusiveness of traumatic memories at that time. Cortisol excretion diminished in the course of the interview and showed the same pattern for both groups. No specific response was detectable after the supposed stressor. Correspondingly, ratings of subjective well-being, memories of the most traumatic event(s) and PTSD symptoms did not show any significant difference between groups. A comprehensive diagnostic interview including questions about traumatic events does not trigger an HPA-axis based alarm response or changes in psychological measures, even for persons with severe PTSD, such as survivors of torture.

Acute psychosocial stress induces working memory impairments

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It is well known that acute stress impairs the retrieval of material from the hippocampal-dependent declarative memory. These effects are mediated by cortisol which is released in response to the stress induced activation of the hypothalamus pituitary adrenal axis. However, few studies have investigated the influence of stress on working memory and it remains unclear whether stress also influences memory functions mediated by the prefrontal cortex.

In the present study, working memory of 40 young male subjects on a n-back task was tested either, after exposure to psychosocial stress (Trier Social Stress Test) or after exposure to a non-stressful control condition. The working memory demand was manipulated using a 2-back versus a 3-back task version.

Psychosocial stress caused a significant increase in salivary cortisol accompanied by a decrease in mood. Subjects in the stress condition showed a significantly slower reaction time compared to subjects in the control condition. This effect was apparent in the 2-back and in the 3-back condition. The increase in salivary cortisol was correlated with slower reaction times. The results are in line with the hypothesis that impairment of working memory after stress are caused by elevated cortisol levels.

Paper Session 4: Visual Processing II

Chair(s): Verleger, R.

Activating blind fields in hemianopics with a massive moving stimulus enhances visual field enlargements after vision restoration therapy (VRT)

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Background: In recent studies vision restoration therapy (VRT) was carried out with a single-point-stimulation paradigm. We now studied the question if the efficiency of the training can be increased when the entire visual field defect is stimulated by a moving spiral-like stimulus.

Methods: In this cross-over study, 18 patients with visual field defects with prior VRT experience were treated with two training paradigms. Group 1 (n=10) first used enhanced VRT (e-VRT) which consisted of a massive "spiral-like" pattern stimulation in the blind field followed by conventional standard-VRT. Group 2 (n=8) trained in reverse order.

Results: In group 1, stimulus detection improved by 5.9% ($p < 0.01$) after e-VRT. After the second training period (standard-VRT), detection further improved by 1.8% ($p = 0.093$). Group 2 improved their detection performance after the first training period (standard-VRT) by 2.9% ($p < 0.05$). After e-VRT, the percentage of high-resolution perimetry (HRP) hits improved significantly by 2.9% ($p < 0.05$). All changes in fixation performance were unrelated to visual field enlargements. Detection performance increased twice as much after e-VRT (4.2%) than after standard-VRT (2.4%; $p < 0.05$) and the detection gains after e-VRT were located mostly in the field of absolute blindness.

Conclusion: The superiority of e-VRT and the location of the detection gains deep in the hemianopic field are interpreted as indirect evidence that extrastriate regions can be recruited to contribute to visual field restoration via activation of the extrastriate pathway. These pathways are thought to be involved in "blindsight" and they by-pass the damaged visual cortex, stimulating extrastriate cortical regions.

Temporal contrast sensitivity during smooth pursuit eye movements

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During smooth pursuit eye movements, stimuli other than the pursuit target move across the retina, and this might have an effect on their detectability.

We measured detection thresholds for vertically oriented Gabor stimuli with different temporal frequencies (1, 4, 8, 12, 16, 20 and 24 Hz) of the sinusoids. Observers kept fixation on a small target spot that was either stationary or moved horizontally at a speed of 8 deg/s. The sinusoid of the Gabor stimuli moved either in the same or in the opposite direction as the pursuit target. Observers had to indicate whether the Gabor stimuli were displayed 4 deg above or below the target spot.

The results show that contrast sensitivity was mainly determined by retinal image motion, but slightly reduced during smooth pursuit eye movements. Moreover sensitivity for motion opposite to pursuit direction is reduced in comparison to motion in pursuit direction. The loss in sensitivity for peripheral targets during pursuit is interpreted in terms of space-based attention to the pursuit target. The loss of sensitivity for motion opposite to pursuit direction is interpreted as feature-based attention to the pursuit direction. Implications for the coding of video sequences arise from these results.

Why Left Events Are the Right Ones in the Attentional Blink: Neural Mechanisms Underlying the Left-Hemifield Advantage For Perceiving Targets in Rapid Series

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It is by lesions of the right-hemisphere temporo-parietal junction that the hemi-neglect syndrome occurs most often. This suggests that the right hemisphere is dominant for processes leading to awareness. To study the contributing mechanisms in healthy humans, we used a task in which unusually strong right-hemisphere dominance of visual perception can be observed: a two-stream version of the attentional blink paradigm. To control for any impact of deviating gaze, we replicated the main experiment with infra-red tracking of eye movements. In accordance with drastically better perception of left-hemifield than right-hemifield targets, electrophysiological measurement of interhemispheric differences revealed right-hemisphere advantages in continuous engagement, in modification of activation by expectancy, and in rapid interruption of other-hemisphere activation. Damage to each of these processes might contribute to the severe disturbance of perception in hemi-neglect.

Paper Session 5: Social Cognition

Chair(s): Pauli, P.

When we prefer men and women at the same time: Effects of gender categorisation on facial mimicry

Likowski, K. U., Mühlberger, A., Rieger, S., Seibt, B., Pauli, P., Weyers, P.

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Humans tend to react with congruent facial muscular reactions when looking at an emotional face. The following study was designed to test the influence of salience of gender identity on this phenomenon of facial mimicry. It thereby combines research showing no impact of the vis-à-vis person's gender on facial mimicry when gender identity is not salient with findings of overall enhanced mimicry reactions to ingroup and counter-mimicry reactions to outgroup members. We manipulated our female participants' focus of identity by categorizing them as "women" or "students". Afterwards they had to look through emotional expressions (happy, neutral and sad) of male and female characters. During picture presentation, M. Zygomaticus major and M. Corrugator supercilii activity were recorded electromyographically. As expected, when gender identity was not salient no differences in facial mimicry reactions to male and female emotional faces were found. However, in the gender categorization condition women responded with enhanced facial mimicry to sad expressions of female as compared to male characters. By contrast, when looking at happy faces women showed stronger congruent muscle reactions if the expression was shown by a male. These results suggest a clear dissociation of facial from behavioral mimicry regarding the processes involved.

Vasopressin increases aggression in social interaction in humans

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Insight into the neurobiological basis of social interaction in healthy humans may provide an opportunity for a better understanding of mental disorders with social deficits (e.g., autism, social phobia). In animal research, arginine-vasopressin (AVP) and oxytocin (OT) play a key role in the regulation of social behavior (e.g. Ferris et al., 2006; Lim & Young, 2005). Recent studies in humans indicate that OT reduces anxiety and stress (Heinrichs et al., 2003) and enhances trust in humans (Kosfeld et al., 2005), whereas AVP is associated with an increase in anxiety and aggression both in animals (Veenema et al., 2006) and humans (Coccaro et al., 1998). In a double-blind, placebo-controlled randomized trial, 288 male subjects received OT, AVP or placebo intranasally and participated in a standardized social interaction paradigm ("altruistic punishment", De Quervain et al., 2004) with the possibility to trust and punish if they got betrayed. In addition, saliva samples (testosterone and

cortisol), blood pressure, and repeated psychometric measures of mood, anger, and anxiety were assessed. AVP significantly enhances the readiness to punish an unfair partner. The AVP group and OT group differ significantly in the average punishment and in the maximum punishment. The groups do not differ in psychometric measures such as anger and anxiety state. The study provides initial behavioral data underpinning the role of AVP in aggression or antisocial behavior in humans. The findings concur with results from animal research and previous studies in humans (Coccaro et al., 1998; Thompson et al., 2004) and may contribute to a substantial progress in understanding dysfunctional social behavior. Further studies in patients with social disorders are needed to evaluate the clinical implications.

Self and other dimensions in an attachment priming task: combination of fMRI and psychophysiology

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This study compares the differential neural activation of self-related dimensions and other-related dimensions in a semantic conceptual priming task for the assessment of human attachment representation. 12 healthy volunteers, 7 males and 5 females, were MR-scanned while responding to a series of sentence statements presenting either self-centered or other-centered perspectives. Endorsement or rejection of statements was recorded, and skin conductance levels were measured online during task completion. Stress or neutral conditions were constituted by subliminal visual presentation of sentence information introducing separation distress or non-emotional content. Both neural and autonomic responses were analyzed in event-related fashion. The main region to be activated in neutral self-related trials was an enclosure in the left supramarginal gyrus (BA 40; -26 -45 31; 423 voxels, $P < 0.0007$). The main region to be activated in other-related neutral trials was the left anterior insular gyrus/frontal operculum (-47 19 9; 277 voxels; $P < 0.002$). The introduction of attachment-related stress produced strong enrichment of cerebral activation of mental person representations, leading to shifts of cluster centers and additional activation. The main region to be activated in stress self-related trials was in the left supramarginal gyrus (BA 40; -35 -36 48; 1083 voxels, $P < 0.003$). The main region to be activated in other-related stress trials was the left anterior insular gyrus/frontal operculum (-40 7 20; 136 voxels; $P < 0.0004$). Additional activation in the stress condition were in parastriate visual areas (BAs 18 and 19), and in the dorsal mid-ACC (BA 24).

The facial expression of pain in congenitally blind individuals

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The aim of the present study was to investigate which role learning by observation plays in facial expressions of pain. We tried to answer this question by studying evoked/spontaneous as well as posed facial pain responses in congenitally blind individuals.

12 congenitally blind individuals and 24 aged matched sighted controls were investigated for their evoked facial responses to tonic heat stimulation of various intensities (part 1). Afterwards (part 2), subjects were asked to pose faked facial pain responses of various intensities. Facial responses were analysed using the Facial Action Coding System (FACS).

Regarding evoked/spontaneous facial responses to pain, we found no significant group differences, although blind individuals were less able to encode different pain intensities via their facial responses. With regard to posed facial responses, highly significant differences between blind and sighted individuals were found. Whereas sighted individuals were well able to pose facial expressions of pain, the facial responses displayed by blind individuals were significantly reduced and less pain indicative.

We conclude that learning by observation only seems to play a minor role regarding evoked/spontaneous facial responses to pain, whereas learning by observation seems to be crucial in order to develop appropriate control structures for posed facial pain responses.

Paper Session 6: *Visual Awareness*

Chair(s): Niedeggen, M.

Rivalry among visual word forms: MEG correlates of the perception of real and illusory words

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The illusory word form paradigm evokes a competition between visual word forms embedded in a RSVP sequence (rapid serial visual presentation). The representation of a word is weakened by an orthographically similar predecessor (creep-sheep) and the consecutive presentation of a word fragment activates a plausible alternative (creep – sheep – ift: shift). In contrast to a reconstruction account, we hypothesized that the perception of the ‘real’ (sheep) or the ‘illusory’ (shift) word is determined by early processes in information processing. MEG (magnetoencephalography) was used to explore the temporal dynamics of the competition among word forms and its neural implementation. Each subject (n=15) received 200 RSVP sequences and the MEG responses were separately averaged for the corresponding verbal reports (real word vs. illusory word). Significant differences were already expressed immediately following the offset to the word fragment (0-150ms). An upcoming report of the real word was indicated by an enhancement of activation in the visual word form system (left fusiform gyrus). The report of an illusory word was preceded by an early activation of a conflict monitoring system (left anterior cingulate cortex). The latter finding indicates that a higher-order system contributes to the resolution of the conflict between real and illusory words.

Percept-dependent ERP-modulations following binocular rivalry of stimulus features shape and colour

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Binocular rivalry occurs when two different images are presented to the two eyes: a perceptual alternation takes place, that only one image is perceived at one time while the other one is suppressed. We used binocular rivalry as a tool to investigate percept-dependent neuronal correlates, and compared them between two stimulus features, namely shape and colour. We dichoptically presented red/black and green/black radial frequency patterns of different shapes, and measured event-related potentials (ERPs) following transitions from binocular rivalry to fusion stimulation. For such transitions, two different conditions can be separated depending on the prevailing percept reported by the observer: transitions concerning the eye which was dominant (percept-incompatible) or suppressed (percept-compatible). In

the shape task, observers reported the currently perceived shape (constant colour), whereas in the colour task, they reported the currently perceived colour (constant shape). The results indicate that the first ERP-difference between percept-incompatible and percept-compatible transitions occurred earlier following shape rivalry (around 120ms) than following colour rivalry (around 220ms). In both tasks, incompatible changes elicited larger ERP-amplitudes than compatible changes. In conclusion, stimulus features determine the stage of percept-dependent processing of visual stimuli: shape processing is affected earlier than colour processing

Stimulus Processing in Binocular Rivalry

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When our eyes are presented with stimuli too different to be integrated in a common percept, they compete for dominance (binocular rivalry). While one of the stimuli is perceived, the other one is suppressed. Perception typically oscillates between the two possible images.

Probes presented to the suppressed eye, interrupt the current dominance phase, but the sensitivity for them is decremented. Thus, the question arises whether sensitivity is reduced in general or whether the attentional shift is delayed.

To examine this hypothesis, the N2pc component was measured as an index of attentional shift in the event-related potential. This component was identified as a correlate of attention in visual search tasks. It occurs 200-300 ms after stimulus onset and shows a stronger contra- than ipsilateral activity in reference to stimulus position. The current experiment shows that the identification of a stimulus presented to the suppressed eye is impaired as reflected by an increase in reaction time. The onset and peak latency of the N2pc component did not differ between both conditions. Thus, although no differences in early ERP components like P1 or N1 were observed, the reduction in N2pc amplitude points rather at a sensitivity decrement than to a delayed attentional shift.

Paper Session 7: *Error Processing*

Chair(s): Stahl, J.

Is action-monitoring in OCD modulated by the significance of an error?

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Previous studies in patients with obsessive-compulsive disorder (OCD) revealed evidence for excessive action monitoring in these patients. In neuroimaging studies OCD patients show hyperactivity of fronto-striatal brain regions; in ERP studies incorrect responses elicit increased error (related) negativity (Ne or ERN) amplitudes. The present study was designed to further investigate whether action monitoring in OCD is modulated by the significance of an error. 22 OCD patients and 22 healthy controls performed a modified flanker task in two conditions: one standard condition and a second condition in which committing an error caused a monetary loss. In healthy controls Ne/ERN amplitudes were significantly increased in the monetary loss condition compared with the standard condition. OCD patients had significantly larger Ne/ERN amplitudes than controls in the standard condition. Importantly, Ne/ERN amplitudes of OCD patients were not modulated by the expectation of a monetary loss. Our results support the view that increased Ne/ERN amplitudes in OCD patients are due to a trait-like overactive action-monitoring system.

Cognitive “compensatory” mechanisms in preclinical Huntington’s Disease

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Huntington’s disease (HD) is a neurogenetic disorder, accompanied with damage of the basal ganglia. In the presymptomatic phase (pHD), compensatory mechanisms occur, delaying clinical onset. These are mediated via the adenosine system. The adenosine system is functionally connected to the dopamine (DA-) System and also mediates pathogenetic effects. The “error negativity” (Ne), indicating performance monitoring, is dependent on the DA-System and may thus indirectly reflect processes occurring in the adenosine system, due to the functional connection. There was no difference in the Ne and behavioural data between the pHD and a control group. Since the Ne is likely to depend on different frequency-bands: a “cognitive” delta-component and a “motoric” theta-component; a wavelet analysis was performed subsequently. It is shown that the pHD-group reflect a selective increase delta-component-power. This was inversely related to the estimated age of onset (eAO), indicating the time point, when the disease may get symptomatic. The results are paradox: Due to the behavioural data the increase suggests compensation. Due to

the relation to the eAO the results suggest for pathogenesis. Thus the results mirror paradox neurobiological processes. Compensation and pathogenesis may be not foreclosing processes and can be expressed on a solely cognitive level.

Neural correlates of performance monitoring in adult patients with Attention Deficit Hyperactivity Disorder (ADHD)

Herrmann, M. J., Pfahler, K., Schreppe, T., Jacob, C., Heine, M., Boreatti-Hümmer, A., Ehli, A.-C., Scheuerpflug, P., Pauli, P., Lesch, K. P., Fallgatter, A. J.

Klinik für Psychiatrie und Psychotherapie

In this study, the neural correlates of error processing in adult patients with Attention Deficit Hyperactivity Disorder (ADHD) are to be investigated. Recent studies in children suggested, with some inconsistencies, deficits in error processing. Based on an analogue study with students we hypothesized that ADHD patients show reduced amplitudes in the event-related potential (ERP) of the Pe (error positivity) but normal amplitudes in the ERP of the Ne/ERN (error-related negativity) after incorrect responses. In this study we investigated 43 adult ADHD patients and 43 healthy controls with a modified version of the Eriksen flanker task while we measured the neural brain activity with 21 scalp EEG-electrodes. Additionally we measured the ERPs to emotional pictures. As hypothesized, we found reduced Pe amplitudes in ADHD patients. As we did not find any differences in emotion related ERP components (Ne and slow wave) between ADHD patients and healthy controls, we conclude a specific deficit in conscious error processing and not a general deficit in evaluation processes in adult ADHD patients.

Medial-frontal negativity and centro-parietal positivity indicators of response uncertainty in a visual masking task

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Error (related) negativity (Ne/ERN) is a component in the event-related potential with a fronto-central maximum that peaks about 100ms after a response. It was discussed as a mismatch signal between representations of the correct response and the actual response. A similar component, however, occurs also after correct responses. A further component, error positivity (Pe), has a centro-parietal maximum and shows its peak about 250ms after an error response. Pe was suggested as a reflection of conscious error processing. To investigate the relationship between the two components and error processing, a masking task was administered to 30 participants. The response signals (<<<, >>>) were followed by a mask with varying onset (SOA: 0, 17, 51, 84, 119ms) to manipulate response uncertainty. The shorter the SOA was, the more difficult error detection should be. The results showed that there was an increase in Ne/ERN amplitude on correct trials with decreasing response uncertainty. However, on error trials the highest Ne/ERN amplitudes were

obtained in the 0-, 17-, and 119ms conditions. These findings challenge the error-detection view of Ne/ERN. Pe was not observed on correct trials, but on error trials. Pe amplitude increased with reducing response uncertainty. This supports the idea of Pe as a reflection of conscious error processing.

Paper Session 8: *Executive Functions*

Chair(s): Kopp, B.

Dual-task-related modulation of activity in posterior task-relevant brain regions

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Little is known about how neural activity in posterior task-relevant brain regions is regulated during interference processing in dual tasks. We hypothesised that activity in regions for the two component tasks depends (a) on the task relevance of Task2 stimuli and (b) on the degree of temporal overlap between the stimuli. We manipulated both factors in a mixed blocked and event-related fMRI study. In each trial, participants performed a choice reaction on faces as Task1. In half of the blocks, participants were instructed to ignore a second number stimulus (ignore-S2) presented at different stimulus onset asynchronies (SOA). In the other blocks, participants performed a choice reaction task on the number stimulus as well (respond-S2). Task-relevant regions for face and number processing were determined with localizer tasks.

The behavioral results indicated RT2-slowing with decreasing SOA. RT1 remained fairly constant across SOAs, being slowed in the respond-S2 condition compared to the ignore-S2 condition. fMRI data: Activity in the Visual Wordform Area (Task2) depended on task relevance of the number stimuli only (respond-S2 > ignore-S2). In the Fusiform Face Area (Task1), we found SOA-effects independent of S2 relevance, indicating modulation of posterior brain regions to deal with task relevance and perceptual interference, respectively.

Attention and distraction within a single feature dimension

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We investigated the mechanism of involuntary attention change and reorientation in an auditory distraction paradigm using the method of event-related potentials (ERPs). Participants discriminated ascending and descending tone-pairs presented in a sequence. The pitch difference between the tones was 1 or 5 semitones (1ST or 5ST). In the Oddball Condition 90% of the trials were 1ST, 10% were 5ST (ascending and descending) trials. To control for the perceptual difficulty difference between 1ST and 5ST trials, each tone-pair was presented with equal probability in the Control Condition.

In the Oddball Condition, infrequent 5ST trials elicited the mismatch negativity, P3a and reorienting negativity (RON), suggesting that these stimuli cause distraction

despite deviating in the task-relevant dimension. These results suggest that (1) the selective attention set in this task does not encompass the entire task-relevant feature-dimension (pitch-difference), but probably only the frequent feature-values (1ST differences); and that (2) RON does not reflect an attention switch between stimulus dimensions.

Effects of anterior cingulate fissurization on cognitive control during Stroop interference

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ZNF, Universität Trier

The midcingulate cortex, as part of the anterior cingulate region, is thought to play a major role in executive processes like conflict monitoring and response selection. Regarding midcingulate fissurization, the occurrence of a second or paracingulate sulcus is more common in the left than in the right hemisphere and seems to indicate a relative expansion of cingulate area 32'. This cytoarchitectural field consistently exhibits activations during conditions of conflict in interference tasks. The current study compared subjects with a low and a high degree of left hemispheric midcingulate fissurization while collecting behavioral as well as electrophysiological correlates of Stroop interference. A high degree of fissurization was associated with decreased behavioral Stroop interference accompanied by a stronger and prolonged frontal negative potential to incongruent trials starting around 320 ms. This increased frontal negativity is assumed to reflect an enhanced activity of a conflict monitoring system located in the midcingulate cortex. In contrast and starting around 400 ms, subjects with low fissurization revealed an increased positivity over parieto-occipital regions suggesting a compensatory need for enhanced effortful cognitive control in this group. These results contribute to the understanding of the neuronal implementation of individual differences regarding executive functions.

Event-related brain potentials obtained from a new oddball task

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linikum Braunschweig

Decision-making is a fundamental capacity which is crucial to many higher-order psychological functions. Nevertheless, little is known about its neural implementation in the human brain. Here, we recorded event-related potentials (ERPs) during a multidimensional visual oddball task. Targets were selected on the basis of a particular conjunction of color and form, tied to a single object in space. The discriminability of the colors was manipulated in three conditions to determine the effects of perceptual distinctiveness on temporal dynamics of decision-making. ERP measures that reflect temporal dynamics of the accumulation of sensory evidence (selection negativity, SN), of the integration of sensory evidence supporting

perceptual decisions (P2a, P3b), and of the resolution of interference (P3a, N2c) were identified. Of particular importance was the finding that distractors that were made up of target-compatible colors, but not distractors that comprised target-compatible forms, evoked the P3a and the N2c, but only when the colors were salient. This finding suggests that distractors which possess salient target-defining features need to be rejected by late selection, whereas other distractors would be rejected by early selection.

Paper Session 9: *Genderspecific Processing*

Chair(s): Stockhorst, U.

Relationship Quality over the Course of the Menstrual Cycle

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Relationship quality was shown to predict not only the stability of the relationship, but individual health and longevity in humans. Conversely, studies on attachment motivation during the course of the menstrual cycle imply that relationship quality itself might be influenced by biological factors.

We investigated if self reported relationship quality depended on the menstrual cycle stage, and if this influence was mediated through mood and hormonal contraceptives (HC) in women.

In a prospective design over the course of four weeks, we asked 60 women to weekly evaluate their relationship quality, mood, and to provide information about HC, relationship criteria and their menstrual cycle status. Menstrual cycle phases (luteal phase, menstrual phase, follicular phase, ovulatory phase) were assigned based on the onset of the last period.

Hierarchical linear modeling (HLM) of the data shows a significant increase in relationship quality from the luteal phase to the ovulatory phase of the menstrual cycle. This time effect was not influenced by mood or HC.

Our data indicate an important influence of the menstrual cycle phase on relationship quality in both normally cycling women and women using HC. Cognitive and endocrine factors that might mediate this relationship will be discussed during the presentation.

Long-term effects of intranasally administered insulin in healthy men and women

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Data obtained in animals and humans indicate that insulin has interesting effects in the brain, e.g. on CNS-mediated food intake, body-weight, memory and hormones. Gender modifies the food-intake effects: Few studies show that only males demonstrate the expected reduction of food intake and body-weight. Currently, we conduct a longitudinal study. Twenty-four healthy men and 24 women (no contraceptives) of different BMI are randomly assigned to self-administer either intranasal insulin (3 x 20 iU/day) or placebo (3 x 0.2 ml/day) in weeks 1-8. In weeks

9-16 (follow-up), half of the subjects/group apply placebo compared to no substance. In weeks 1-9, 12 and 16, subjects have one weekly session in the laboratory where blood glucose, insulin, leptin, cortisol, estradiol, memory, symptoms, body-weight and circumference are assessed. In single weeks, food intake, body composition, and EVPs are additionally measured in the laboratory. At home, subjects daily assess blood glucose and symptoms; temporarily they record sleep behavior, physical activity and food intake. The study is in progress. First data are reported.

Is there a sex difference in left-right confusions?

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It is widely believed that sex differences in left/right confusions do exist. When asked to self-evaluate the own performance in left/right judgements, women tend to give themselves lower ratings than men. However, recent research suggests that sex differences in left-right-confusion exist but depend on the left/right-judgement task. To examine task-related conditions under which sex differences in left-right differentiation emerge, 63 healthy subjects (41 women and 22 men) were tested in three experiments. In the first experiment, participants performed an irrelevant task, while pressing two buttons. They were abruptly asked to release the left or right button. In experiment 2, participants had to decide whether pictures of rotated pointing hands showed left or right hand. In experiment 3, participants were asked to touch or move left or right body parts under time restrictions. No sex differences appeared in Experiment 1 ($t(57) = 0,484$; $p = .63$). Experiment 2, however, revealed more left/right confusions in women than men ($t(57) = -2.79$; $p < .01$). Similarly, women produced slightly more errors in experiment 3. However, this effect appeared only as a non-significant trend ($t(57) = 1,94$; $p = .057$). The results suggest that sex differences in left-right-confusion are task-dependent and mainly appear when specific spatial processes, i.e. mental rotation, are involved.

Paper Session 10: *Emotions*

Chair(s): N. N.

5-HTTLPR biases amygdala activity in response to masked facial emotion in depression

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The amygdala is a key structure in a limbic circuit involved in the rapid and unconscious processing of facial emotions. Increased amygdala reactivity has been discussed in the context of major depression. Recent studies reported that amygdala activity during conscious emotion processing is modulated by a functional polymorphism in the serotonin transporter gene (5-HTTLPR) in healthy subjects. In the present study, amygdala reactivity to displays of emotional faces was measured by means of fMRI at 3 T in 35 patients with major depression and 32 healthy controls. Conscious awareness of the emotional stimuli was prevented via backward-masking in order to investigate automatic emotion processing. All subjects were genotyped for the 5-HTTLPR polymorphism. Risk allele carriers (S or LG) demonstrated increased amygdala reactivity to masked emotional faces, which in turn was significantly correlated with life-time psychiatric hospitalization as an index of chronicity. This might indicate that genetic variations of the serotonin transporter could increase the risk for depression on chronification via altering limbic neural activity on a preattentive level of emotion processing.

Threat detection: Selective attention and startle reflex modulation

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Visual search tasks with facial expressions of emotions (face-in-the-crowd-task) show an advantage for the detection of angry faces compared to happy faces. It is assumed that the amygdala plays a key role in this effect. To test this assumption, the modulation of startle responses by pictures of different facial expressions was taken as an indicator of amygdala activation and related to threat detection in a face-in-the-crowd-task. Contrary to the expectation, the modulation of the startle reflex by angry faces was not related to the detection of angry faces in the face-of-the-crowd-task. However, when startle responses during the presentation of neutral faces were considered, only S.s with pronounced (>Md) responses showed an advantage for the detection of angry faces. In order to amplify the ambiguous impression of the neutral faces, a second study additionally used pictures in which angry expressions (lower spatial frequencies) were laid underneath the neutral expressions (higher spatial frequencies). An advantage for the detection of angry faces was only found for S.s with pronounced (>Md) startle responses during the presentation of the more

ambiguous faces. The results are consistent with other findings according to which the amygdala is especially involved in the processing of uncertain signals of threat.

Motivated behaviour in rats and cytokines

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There is evidence that immune messengers like cytokines can modulate motivated behaviour, and are involved in psychiatric conditions like anxiety, and depression. In previous studies, we showed that cytokine expression in specific brain tissues correlated with anxiety-like behaviour (open arm time) in the elevated plus-maze in male Wistar rats. These relationships indicated that cytokines in the brain can be related to avoidance behaviour, and that this relationship is site- (striatum, frontal cortex), and cytokine-specific (interleukin-2 mRNA). Subsequently, we tested rats after a single striatal interleukin-2 injection followed by an elevated plus-maze, or open field, test acutely and 24 h later. Overall, rats with interleukin-2 showed dose-dependent effects for anxiety-like behaviour, particularly with the lowest dose tested (0.1ng) compared to saline control rats. In addition, dose-dependent suppression of rearing activity (often interpreted as exploratory behaviour) was shown for interleukin-2 doses (0...1ng; 1ng) compared to controls. However, measures of locomotion did not differ between groups so that general activity cannot account for these differences. Therefore, in the subsequent ongoing study we tested for proactive drug mechanisms, that is, rats were tested in an open field 24 and 48 hours after interleukin-2 injection. The results are expected to be available for the presentation.

Influence of attention on the perception of breathlessness

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Breathlessness is an impairing symptom in various cardiorespiratory diseases but little is known about the influence of psychological factors on this unpleasant sensation. We therefore studied the influence of attention on the perception of breathlessness in two studies. Breathlessness was induced in 44 healthy volunteers by resistive load breathing (study 1) and in 20 patients with chronic obstructive pulmonary disease (COPD) by a standardized 6min walking exercise test (study 2). In both studies, participants experienced breathlessness during two experimental conditions: attention (=focused on breathing) and attentional distraction. Attentional distraction was achieved by reading texts (study 1) or by distractive auditory stimuli (study 2). Perceived unpleasantness (i.e. affective dimension) and intensity (i.e. sensory dimension) of breathlessness were measured with separate visual analog scales in both experiments and respiration was monitored continuously. Respiratory parameters in both studies confirmed a similar level of respiration/respiratory challenge in both experimental conditions. In both studies,

attentional distraction significantly decreased the perceived unpleasantness of breathlessness compared to the attention condition ($p's < 0.05$), while the intensity of breathlessness showed no changes across conditions.

The results of both studies suggest that attentional distraction specifically reduces the perceived unpleasantness of breathlessness which might serve as behavioural intervention in pulmonary rehabilitation programs.

Paper Session 11: *Cortical Flexibility*

Chair(s): Hirnstein, M.

The evolutionary origins of cerebral asymmetries in humans: Does lateralization enhance parallel processing?

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Hemispheric asymmetries are present in most vertebrates (e.g. fish, amphibians, reptiles, birds and mammals) and can be found on various levels, such as neuroanatomy, neurochemistry and behaviour. However, although various kinds of structural and functional asymmetries have been described in various species, little is known about why they have evolved. The ubiquity of hemispheric asymmetries suggests that an evolutionary selection advantage exists. According to a prominent hypothesis, an asymmetric brain should be associated with advantages in parallel processing, i.e. doing two tasks simultaneously. Using a visual half field procedure, we wanted to test whether this hypothesis also applies to humans. Thirty-two participants (17 women and 15 men) were investigated. First, we assessed the degree of lateralization in a face/nonface and a word/nonword discrimination task favouring the right and left hemispheres, respectively. Based on a median split, subjects were divided into a rather symmetric and a rather asymmetric group. Then, all participants completed both tasks simultaneously: The rather symmetrically organized participants outperformed asymmetric participants accuracy and response times. Hence, one of the most prominent hypotheses about the emergence of lateralization seems to be questionable.

Multisensory processing of congruent and incongruent auditory-visual movie clips of everyday actions

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Event-related potentials (ERPs) were used to determine the role of semantic congruity in the processing of audiovisual movies of everyday actions (taking steps, opening a door, ...), presented either unimodally or bimodally, in congruent or incongruent combinations. Incongruent combinations elicited a broad frontocentral negativity. A source analysis of this effect points to a generator located in the anterior cingulate gyrus. In addition to this late N400 like effect, early components of the ERP for incongruent stimuli had higher amplitudes than the early components observed in congruent stimuli. We discuss potential origins of this early effect. In a second analysis, stimuli were classified into seven categories (office, kitchen, ..., and a none category for remaining stimuli). This analysis revealed that semantic incongruity only partially accounts for the negative effect. It seems rather that the majority of the N400

effect is due to an ongoing search process called structural description matching (Ganis and Kutas, 2003, *Cognitive Brain Research*, 16, 123-144), which primarily depends on the typicality of the stimulus.

The anterior N1 component as an index of modality shifting

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Facilitated processing of a given target can be observed when it is presented within the same (e.g. visual - visual), relative to a different (e.g. tactile - visual), modality as the previous trial (Spence et al., 2001). Within two experiments, the present study was designed to identify the electrocortical correlate underlying this 'modality shift effect'. While recording EEG, participants had to discriminate (via foot responses) the modality of the target, which could appear equiprobable within the visual (LEDs) or the tactile (5 mV solenoids, attached to index fingers) modality. While in the first experiment modality changes were associated with response changes, the second experiment dissociated both types of changes. Both experiments replicated previous behavioural findings showing prolonged RTs for modality changes relative to modality repetitions. Independently from the target's modality and motor responses, this effect was mirrored by enhanced amplitudes of the anterior N1 component.

These findings can be explained by adopting 'weighting mechanisms' as postulated by the 'dimension-weighting' account (Found & Müller, 1996) for visual processing. From this perspective, the anterior N1 might reflect a weight shifting process which is needed to transfer attentional weight from the old to the new target-defining modality as a pre-condition for target detection.

Automatic detection of abstract regularity violation in audition and its consequences for other mental processes

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Institut Psychologie I der Universität Leipzig

The capacity for abstraction is beneficial for adaptive behavior in a complex environment. The present study investigated the non-intentional encoding of auditory rules, the automatic detection of sounds violating the rule, and its consequences for other mental processes, namely the interference with the processing of task-relevant information and the facilitation of behavioral violation detection. Rules consisted in a constant frequency relation between two tones of a tone pair while the absolute frequencies of the tones varied randomly between pairs. When subjects performed a task not related to the sounds, the elicitation of the Mismatch Negativity (MMN) revealed the auditory system's capability to automatically encode abstract rules and to register events violating them. When subjects performed a task related to the sounds but not to the rule, none of the subjects acquired explicit knowledge of the rule nor became aware of the presence of rule violations. Nevertheless, violations

were followed by MMN and a subsequent P3a as well as impaired performance in the primary task indicating an involuntary switch of attention. When subjects were informed about the rule and trained to detect the violations, only detected violations elicited MMN and P3a confirming the functional role of the neural substrates for detecting violations.

Paper Session 12: *Affective Processing*

Chair(s): N. N.

Brain activation during anticipatory anxiety in spider phobics

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FSU Jena

Anticipatory anxiety during expectation of phobogenic stimuli is an integral part of abnormal behaviour in phobics. The neural basis of anticipatory anxiety in specific phobia is unknown. Using functional magnetic resonance imaging (fMRI), we explored brain activation in subjects with spider phobia and in non-phobic subjects, while participants anticipated the presentation of either neutral or phobogenic visual stimuli. Subjective ratings indicated that anticipation of phobia-related stimuli was associated with increased anxiety in phobics but not in healthy subjects. fMRI results showed increased activation of the dorsal anterior cingulate cortex (ACC), insula, thalamus, and visual areas in phobics compared to controls during anticipation of phobia-relevant versus anticipation of neutral stimulation. Furthermore, for this contrast, we found also increased activation of the bed nucleus of the stria terminalis (BNST). This particular finding supports models, which propose, based on animal experiments, a critical involvement of the BNST in anticipatory anxiety. Finally, correlation analysis revealed that subjective anxiety of phobics correlated significantly with activation in rostral and dorsal ACC and the anterior medial prefrontal cortex. Thus, activation in different ACC regions and the medial prefrontal cortex seems to be specifically associated with the severity of experienced anticipatory anxiety in subjects with spider phobia.

Blunting of affective reactivity in clinical depression

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Ernst-Moritz Arndt Universität Greifswald

To test the hypothesis of general emotional blunting in clinical depression, affective pictures and sounds of different content categories were presented to 10 depressed patients seeking for psychotherapy. Patients showed overall reduced startle responsiveness but more importantly also displayed clearly impaired affective modulation of the startle responses. This pattern of results was also supported by corrugator activity and verbal report. These data support the hypothesis of emotional blunting on different emotional response levels in clinical depression. Implications of these data for clinical work will be discussed.

Neural correlates of emotion induction and working memory performance in an n-back task

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There is a lack of functional magnetic resonance imaging studies on the interaction of working memory (WM) and affective processing. We tested the hypothesis that the induction of negative emotions (fear, disgust), would interfere with WM processes in prefrontal cortex regions. Brain activation was recorded from 20 females who participated in an n-back paradigm with fear-inducing, disgust-inducing and neutral pictures serving as WM stimuli. Picture presentation followed a block design for the WM conditions (0-back, 2-back). Affective ratings, as well as personality traits such as disgust sensitivity, were assessed. The emotion induction was realized successfully as indicated by the affective ratings. No interactions of emotion x WM conditions were observed when analysing behavioural data. The contrast 2-back > 0-back revealed anterior cingulate cortex activation when comparing fear and disgust stimuli with neutral stimuli. Negative correlations between right dorsolateral prefrontal and left parietal cortex activation with disgust sensitivity were observed for the disgust condition. Our results imply that subjects increased their attentional effort in the 2-back condition in order to compensate for emotion effects. Despite the fact that disgust sensitivity affected those regions associated with WM, it did not reduce WM performance.

The role of feedback in decision-making under risk conditions: Psychophysiological and behavioural correlates

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In decisions under risk conditions, i.e., when the outcome is defined by probabilities and the amount of gains and losses is offered by the decision situation, both the use of feedback and executive functions are hypothesised to influence decision-making. In the present study, psychophysiological (skin conductance responses, SCRs) and behavioural correlates of feedback processing were assessed experimentally. Two samples of healthy individuals were examined with the Game of Dice Task, a task which offers explicitly the rules for gains and losses and in which participants receive feedback after each trial. In the first experiment (n=20), SCRs were measured in both the decision-phase and the feedback-phase. In the second experiment, the subjects (n=30) also performed a modified version of this task, in which the feedback was removed. Results: The SCRs for risky and non-risky decisions were significantly different in the feedback phase ($t=4.11$, $p=.001$) but not in the anticipatory phase ($t=2.17$, $p=.046$, non-significant after Bonferroni correction). In the second experiment, participants chose the risky alternatives more frequently in the modified Dice Task without feedback compared to the original Dice Task ($t=3.73$, $p=.001$). Conclusion: Under risk conditions, processing the feedback from previous trials can positively influence decision-making and co-varies with psychophysiological responses.

Postersession I

Separate cortical stages in amodal completion revealed by functional magnetic resonance adaptation

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In our environment objects are often partly occluded, yet we perceive them as whole and complete without difficulty. This phenomenon is called visual amodal completion. Psychophysical studies suggest that the process of completion starts from a representation of the (visible) physical features of the stimulus and ends with a completed representation of the stimulus. Using an adaptation paradigm in functional magnetic resonance imaging we reveal clearly distinct regions in the human visual cortex that are involved in processing of amodal completion: primary visual cortex processes the local contour information of the stimulus while regions in inferior temporal cortex represent the completed shape. Furthermore, our data suggest that at the level of inferior temporal cortex information regarding the original local contour information is not preserved but replaced by the representation of the illusory percept. These findings provide neuroimaging evidence for a multiple step theory of amodal completion and further insights into the neuronal correlates of visual perception.

Heart rate (variability) responses to tonic heat pain: Does prolonged pain always have a stress component?

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It is well accepted that pain can be a stressor, especially in its tonic (prolonged) forms. However, it is questionable whether prolonged noxious stimulation per se is sufficient to elicit stress if pain is applied in a situation with low threat and high controllability. The aim of the present study was to answer this question by studying HR and HRV responses to tonic heat pain.

40 subjects (male=20, female=20) were investigated for their HR and HRV responses as well as their subjective responses to tonic heat stimulation of non-painful and painful intensities. The intensities were tailored to the individual pain sensitivity and could be lowered by demand. Since the stressfulness of pain might be modulated by attention, pain was applied in a neutral, focussed and de-focussed condition.

Subjective responses increased significantly from non-painful to painful tonic heat stimulation. In contrast, HR and HRV did not differ between non-painful and painful heat stimulation. Attention had a significant general impact both on HR and HRV as well as on subjective responses, with reduced responses during a distraction task.

Although our tonic heat pain model reached subjectively moderate to strong intensity levels, the HRV and HRV responses did not provide evidence for a stress component, not even in men who are said to be cardially more responsive. The quality of stress appears to be no natural accompanist of prolonged pain.

Hypervigilance as predictor of postoperative pain

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Strong or persistent postoperative pain is still a frequent complication during recovery with enormous subjective and economic costs. Prediction of postoperative pain paves the way for prevention. It has become clear that there is need for psychological predictors because somatic predictors are not sufficient. Hypervigilance, which is an attentional set with a rigid focus on pain and a regular accompanist of chronic pain, appears theoretically apt of being a useful predictor.

Within a prospective longitudinal study 100 healthy men between 14 and 30 years old with congenital deformations of thorax are investigated the day before surgery and four times postoperatively (one week and three, six, twelve months after). Since hypervigilance is defined as a multidimensional concept, it is assessed on four dimensions: implicit focus of attention on pain (dot probe task), explicit focus of attention on pain (hypervigilance questionnaires), pain responsiveness (pain thresholds, pain summation) and hormonal response filters (cortisol reactivity). Outcome variables are pain intensity and pain frequency after surgery, use of analgesics and pain-related functional limitations.

A preliminary regression analysis including 29 patients with one week and 25 patients with three months after surgery showed correlations strong enough to allow for classifying the various hypervigilance measures as very explanatory predictors. Furthermore, the hypervigilance measures contributed largely independent from each other to variance explanation.

Modulation of pain through variations of musical tempo

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The present study investigated the effects of music on pain perception through the manipulation of mode and tempo. Four relatively unknown classical movements were recorded on a MIDI grand piano and then manipulated digitally in mode (major, minor) and tempo (slow [MM = 45]; medium [MM = 60]; fast [MM = 95]), resulting in six variations for each music piece. Thirty eight healthy non-musicians (17 female) listened to all variations of the four pieces while a constant thermal pain stimulus was

applied. The participants evaluated the unpleasantness and intensity of the heat pain as well as their mood and arousal. Throughout the entire experiment heart rate, respiratory rate and end-tidal partial pressure of CO₂ were monitored.

The slower the music the lower were arousal and pain unpleasantness ratings of the female participants. Respiratory rate and heart rate were highest for the fastest tempo. Although musical mode influenced the participants' mood it had no effect on pain perception. The modulation of pain perception through musical tempo seems to be mediated primarily by the listener's level of arousal, with slower tempo leading to lower arousal than faster tempo.

Recognition of Prototypical Dynamic Expressions of Pain and Associated Physiological Responses

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The facial expression of pain has recently become an area of interest in functional neuroimaging. To date, there is a lack of appropriate stimulus material to explore the neurobiological processes underlying the perception of pain expression and its role in the regulation of social behavior. In order to substantially advance work in the field a set of one-second film clips displaying facial expressions of pain and the six basic emotions was developed. Study 1 directly compared the recognition and discrimination of these dynamical stimuli by naïve observers. Coding of facial muscle activity using the Facial Action Coding System confirmed the distinct configuration of pain and basic emotion expressions. Prototypical pain expressions were readily recognized and the discrimination with the basic emotions revealed high sensitivity and specificity. The data further suggests that, for comparable expression intensity, pain is perceived as most arousing and unpleasant, possibly reflecting its higher biopsychosocial significance. Study 2 assessed physiological responses to pain, angry and neutral faces taken from this newly developed set of stimuli. ECG, EDA and facial EMG were recorded while subjects (n=24) performed a gender-discrimination task. Type and amount of physiological mobilization and facial mimicry in the observer were analyzed.

Does caffeine counteract the sleep deprivation-induced enhancement of false memories?

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In a previous study we have shown that sleep deprivation (SD) enhances the occurrence of false memories in the Deese, Roediger & McDermott (DRM) Paradigm. Different stimulants have been proposed to compensate for the negative cognitive effects of SD, of which caffeine is the most renowned and widely-used substance. In the present study we hypothesized that caffeine would reduce the SD-induced enhancement of false memories. Subjects studied 15 semantically related DRM-wordlists in the evening and recognition testing took place the next morning after one night of SD. One hour before retesting, subjects were administered either 200 mg caffeine or placebo according to a randomized double-blind design. Preliminary results indicate that caffeine compared to placebo did not reduce SD-induced enhancement in false recognition of semantically related but never presented words. However, caffeine did reduce subjective sleepiness and improved performance in a psychomotor vigilance task. The results suggest that caffeine can compensate for SD-induced deteriorations only in simple cognitive tasks, but not in more complex cognitive functions which critically depend on the prefrontal cortex.

The role of negative feedback on auditory recognition memory

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Event-related potentials (ERP) recorded during recognition tests have revealed distinct spatio-temporal old/new effects and thought to be related to familiarity, recollection and post-retrieval processes (verification). The present study investigated whether stress affects auditory recognition memory. By means of ERP recordings we further explored a) whether old/new effects are still evident after longer retention intervals and b) which ERP components respond to stress manipulation. Participants performed a learning task followed by a distraction and an insolvable Tower-of-Hanoi (TOH) task. They were randomly assigned to one of two experimental groups receiving either a negative (NFG) or positive (PFG) feedback to their performance in the TOH. In the subsequent recognition task old (already learned) and new environmental sounds were presented. Although the two groups did not differ in recognition accuracy or response bias, the NFG responded significantly slower to correct rejections. ERPs revealed no significant old/new effects in general. However, the spatio-temporal pattern differed between the two groups. While in PFG early frontal and parietal effects were observed, in the NFG a late sustained prefrontal old/new effect was found. Results suggest that the PFG might benefit from early automatic and controlled recollective processes, whereas for the NFG more demanding processing (enhanced verification) is discussed.

Developmental differences in the role of sleep for memory consolidation

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Sleep has been shown in adults to play a crucial role for memory consolidation. Until now, however, it has been unclear whether sleep contributes to a similar extent to memory consolidation in children. In the present study, we investigated the effects of sleep on the consolidation of procedural and declarative memory in 16 children (6 to 8 years) and in 15 adults. Subjects performed two declarative (2D-object location task, word-pair associate learning task) and one procedural memory test (finger sequence tapping task) before and after a retention interval spent either sleeping or awake. Recall of declarative memory was significantly enhanced in both age groups after retention sleep compared to wakefulness ($p < 0.01$). Sleep also enhanced procedural memory consolidation in the adults ($p < 0.05$). In contrast, in the children's group procedural memory benefited more strongly from wakefulness than from sleep ($p < 0.05$). The results emerged on the background of a greater amount of SWS in children than adults. Our results suggest that the impact of sleep on procedural memory consolidation depends on developmental stages, with the sleep-related consolidation of implicit memory in children possibly impaired by the preferential enhancement of explicit aspects during sleep.

Long-Term Memory For Emotionally Pictures: An Event-Related Potential Study

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Recent research provided strong evidence for a memory-enhancing effect of emotionally arousing events compared to neutral ones. In a high-density EEG study we investigated long-term memory for pictures with emotional and neutral contents during a recognition task. In a passive picture-viewing paradigm 90 stimuli (30 unpleasant, 30 neutral, 30 pleasant) were presented for 3 seconds to 20 volunteers. For half of the subjects, pictures were presented in color, whereas the other half viewed the pictures in gray-scale. After one week, subjects returned to the laboratory for a recognition test, during which 90 old pictures and 90 new pictures were presented. Analysis of behavioural data revealed that pictures with high emotional significance were associated with better memory performance relative to neutral pictures. This effect did not vary for presentation mode (color vs. gray). Correctly memorized old pictures elicited more positive ERP waveforms over central and frontal sites in the time range of 450 and 1000 ms after stimulus onset relative to correctly categorized new pictures. In accordance to behavioural data, emotional

pictures showed a more pronounced old/new effect in centro-parietal areas compared to neutral pictures. Presentation mode (color vs. gray) did not influence these recognition-related ERP characteristics.

Oscillatory correlates of short-term memory maintenance of spatial sounds: An MEG study

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Cortical oscillatory gamma-band activity (GBA) is considered a signature of mental representations. However, as yet there is little evidence suggesting that specific GBA components with distinct spectral and topographical characteristics reflect the representation of individual stimuli. To assess the existence of such components, we compared oscillatory signals in magnetoencephalogram during the memory maintenance of different sound lateralization angles. 28 subjects performed a short-term memory task requiring decisions on whether two lateralized noise stimuli S1 and S2 separated by a delay period had the same lateralization angle or not. S1 could deviate from the midsagittal plane by either 15 or 45 degrees to the right or left. Evoked fields showed higher amplitudes contralaterally for the more strongly lateralized sounds. Spectral analysis directly comparing the S1 stimuli revealed separate GBA components (at around 55-75 Hz) tuned to each lateralization angle. The activations were localized in sensors over posterior parietal cortex contralateral to the side of sound presentation and reached their maximum during the middle of the delay phase. The difference between responses to 15- vs. 45-degree stimuli correlated positively with task performance. Possibly these GBA components reflected the activations of cortical networks underlying the short-term maintenance of task-relevant stimulus attributes.

Cortisol elevations, HPA axis dysregulation, and memory impairments in type 2 diabetes

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Background: There is both evidence of hypothalamic-pituitary-adrenocortical (HPA) axis and cognitive dysfunction in type 2 diabetes mellitus (T2DM). However, the exact nature and the associations between these abnormalities remain unclear.

Methods: 30 subjects with T2DM and 30 non insulin resistant age-, gender- and education matched control subjects were tested for HPA axis function employing the combined DEX/CRH test. Cognition was tested using a neuropsychological battery assessing declarative and working memory, attention and executive function.

Results: Individuals with T2DM had elevated basal plasma cortisol levels, higher levels after dexamethasone suppression, and a larger response to CRH (all p's

<.005). Among individuals with T2DM, cortisol levels during the DEX/CRH were positively associated with HbA1c ($p=.05$), independent of age, BMI, hypertension, and dyslipidemia. ACTH levels did not differ significantly between the groups. Diabetic subjects showed cognitive impairments restricted to declarative memory. Across all subjects declarative memory was inversely associated with cortisol levels, however, these associations were subsumed by glycemic control (HbA1c). Conclusion: HPA hyperactivity and declarative memory deficits are present in T2DM. Both alterations may reflect the negative impact of poor glycemic control on the hippocampal formation.

The N400 event related potential associated with coping effectiveness in neurodegenerative disease

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The N400 event related potential has been found to increase in amplitude to words that are not predicted by their surrounding semantic context. Using this semantic congruity effect of the N400, the present study aims to investigate the psychophysiological correlates of the coping abilities of patients with amyotrophic lateral sclerosis (ALS). A list of 217 words was evaluated and categorized by 10 ALS patients into the four groups of positive, neutral, negative, and disease related words. Frequency was evaluated on a scale of 1 to 10. These words were then incorporated into congruent and incongruent sentences. In the EEG experiment, 480 sentences are presented (120 per word category). The effectiveness of coping was assessed by standardized questionnaires. Preliminary data suggest that intercategory differences between the N400 amplitudes are greater for the disease related words if the patients cope less successfully with the disease. We speculate that it is harder for these patients to integrate the words into context and thus, causing a larger N400. We may interpret the N400 as a neuronal correlate for coping.

Brain activation during explicit and implicit processing of phobia-related words in patients with social phobia: an event-related fMRI-Study

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Social phobics show hypersensitivity to disorder-related stimuli such as words describing social interactions or phobic symptoms associated with such situations. Neural correlates of processing phobia-related words in social phobia are unknown. Using functional magnetic resonance imaging (fMRI) this study investigated brain activation during the processing of phobia-relevant and neutral words in twenty

patients with generalized social phobia and twenty healthy controls. The words were presented in an event-related design under two different task conditions. During the implicit task, subjects categorized the type of the word. During the explicit task, subjects had to decide whether words related to social interaction situations or not. During the explicit condition, no between-group differences were detected. However, during the implicit task, social phobics showed decreased activation of rostral ACC/medial prefrontal cortex to phobia-related vs. neutral words. Increased activation in phobics as compared to controls was found in the right orbitofrontal cortex and, as a tendency, in the left amygdala. Activation in both regions correlated significantly with phobic's valence ratings of words. The results suggest a specific role of orbitofrontal cortex and amygdala during processing of phobia-relevant distracting information.

The processing of food cues in eating disorders with binge eating episodes

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The key feature of binge eating disorder (BED) and bulimia nervosa (BN) is the occurrence of recurrent binge eating episodes. Both disorders differ in compensatory behavior (e.g. vomiting), which is only regularly present in BN. The psychophysiological mechanisms underlying binge eating are not yet known in detail. We investigated the neural and affective responses of female patients suffering from BED (n = 17), from BN (n = 18) and healthy controls (n = 25) in a functional magnetic resonance imaging study. The subjects were exposed to pictures depicting high-caloric food.

Relative to the control condition, the food stimuli triggered activation of the orbitofrontal cortex, occipito-parietal regions, the insula and the amygdala in all subject groups.

Group comparisons revealed that BED patients showed greater amygdala and hippocampus activation than the controls and also greater than the bulimics. BN patients displayed stronger insula involvement than the controls. The food pictures were perceived as pleasant by all subject groups. Bulimics however gave lower valence ratings than BED patients and reported more arousal than BES patients and controls.

Altogether, the data suggest that food stimuli are highly rewarding for BED patients and that the amygdala is involved in this type of reward processing.

Brain activation in chronic non-fluent aphasia before and after constraint-induced aphasia therapy

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The role of the right hemisphere in recovering from aphasic stroke remains controversial. We investigated brain activation during reading and word stem completion related to 1) therapeutic intervention, 2.) aphasia severity, and 3.) level of speech improvement.

Using functional MRI we studied activation of language-related areas in 16 chronic non-fluent aphasics and 8 healthy control subjects. Aphasics were studied before and after constraint-induced aphasia therapy and were split in subgroups depending on aphasia severity and level of speech improvement.

Activation of right inferior frontal gyrus (IFG) and superior temporal gyrus (STG) was stronger in aphasics compared to controls and in aphasics with more severe deficits compared to aphasics with fewer deficits. Aphasics with high behavioural improvement showed reduced activation in right middle frontal gyrus (MFG) after therapy. Activation of right STG and right insula decreased in patients with more deficits and increased in patients with fewer deficits after therapy.

Activation of right IFG and right STG is associated with word processing in controls and chronic aphasics. The extent of language-related activation and the pattern of therapy-induced activation changes depend on severity of aphasic symptoms. Therapy-induced improvement in language performance is associated with a decrease in right frontal areas.

Temporal Dynamics of a Discrimination Process between two Spatial Tasks: the visual N1

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The aim of the current study was to analyze the temporal dynamics of a discrimination process between two spatial tasks by means of both reaction times and electrocortical parameters. In a spatial navigation experiment, subjects had to maintain orientation during desktop simulated passages through tunnels consisting of straight and curved segments. After the passage subjects were asked to indicate their current position by adjusting a response arrow in one of two reaction formats: in the homing vector format subjects had to point an arrow from the end-position back to the starting-point; in the start-end format the task was to indicate the end-position with respect to the origin of the path. In one experiment the reaction formats were randomized and unpredictable on a trial. In a second experiment the reaction formats were blocked.

In both conditions a P1-N1 complex related to the response arrow onset became evident after visual inspection at posterior lateral electrodes. The earliest difference

between conditions occurred with respect to the N1-component: in the random compared to the blocked condition the reaction times were longer and the visual N1-component enhanced. Behavioral and electrocortical results reflect the operation of a discrimination process.

Electrocortical correlates of allocentric and egocentric frames of reference in spatial navigation

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The current experiment investigated the electrocortical foundations associated with spatial navigation in a virtual navigation task without landmarks. Participants traversed tunnels with one or two turns ending up at different eccentricities of end position to the left or right relative to the starting point. At the end of the passage subjects had to indicate their momentary position relative to the starting point (point to origin). In order to solve the task subjects showed preference for using an egocentric or an allocentric frame of reference.

The EEG was recorded continuously and the data was analyzed using Independent Component Analysis (ICA) to investigate the spectral perturbation of distinct brain areas subserving the ego- and the allocentric frame of reference.

Both strategy groups showed comparable homing vector accuracy for tunnels with 1 turn. When confronted with 2-turn tunnels, different performance levels were observed.

The spectral perturbation pattern of component clusters revealed for both strategy groups distinct networks reflecting differences in the computation of translational and/or rotational changes in the underlying coordinate systems.

Neural correlates of saccade generation and inhibition: an event-related fMRI study

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The antisaccade task requires the inhibition of a reflexive saccade towards a new visual stimulus and the generation of a volitional saccade to its mirror location. Task preparation in antisaccades (preparing for the task before onset of a target stimulus) compared to prosaccades (simple gaze shifts towards a new target) recruits more brain activity in well-known oculomotor regions, including the frontal eye fields (FEFs) and the supplementary eye fields (SEFs), and in brain areas that are more generally involved in action control, such as the dorsolateral prefrontal cortex. It remains unclear, whether antisaccades recruit the same brain areas during execution.

The present study used event-related fMRI to disentangle the two response components of the antisaccade, inhibition of a reflexive saccade and generation of a volitional saccade, measuring blood oxygen level-dependent (BOLD) signal changes following different oculomotor responses without task specific preparation. 19 healthy participants had to inhibit reflexive glances towards peripheral stimuli both with and without simultaneous saccade generation. Saccade generation consistently activated the FEFs and SEFs. Activation associated with saccade inhibition did not include the FEFs or SEFs but several other frontal and parietal regions. The results suggest that dissociable neural networks are involved in saccade generation and inhibition.

A comparison of action monitoring in younger and older adults

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Event-related brain potential (ERP) studies identified the error related negativity (Ne) and the correct related negativity (CRN) to be specifically associated with action monitoring. Studies investigating age effects on error processing consistently report a Ne reduction in elderly compared to younger adults, while results concerning the CRN are less consistent.

The present study was designed to replicate the smaller Ne in elderly compared to young adults and to examine whether Ne amplitude differs as a function of error power and whether this pattern is similar for younger and older adults. Additionally, we are interested in age effects on CRN. The participants performed a modified flanker task. Ne was measured separately for errors with full activation of the incorrect response (full errors) and for errors characterized by a smaller incorrect activation (partial errors).

Results showed that independent of error power, Ne amplitudes were more negative in younger compared to older participants. In young participants the amplitudes of Ne and CRN differed substantially, whereas this was not the case for older participants. The specific relationship between Ne and CRN in elderly might be due to enhanced uncertainty of older adults concerning their response accuracy.

The importance of response conflicts and memory-related processes for the detection of concealed information

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The Guilty Knowledge Test (GKT) is a highly valid technique for the detection of concealed information. Its psychophysiological substantiation is, however, still debated. We conducted two experiments to examine the role of response conflicts and memory-related processes in a GKT examination. Participants were instructed to conceal knowledge of two specific probe items that were presented to them along with several irrelevant items and rare targets while measuring skin conductance and

fMRI data in an event-related design. In one experiment, different behavioral responses were required for targets, thus, response conflicts occurred. The other experiment did not comprise response monitoring demands. Results revealed that probe trials were accompanied by larger skin conductance responses and increased activity in bilateral inferior frontal regions than trials with irrelevant items. This response pattern was observed in both experiments but its magnitude was modulated by response conflicts and depth of processing effects. Taken together, memory-related processes seem to be necessary for evoking distinct physiological responses to concealed and irrelevant information in a GKT examination. Response conflicts enhance this differential responding but our results clearly show that deception is no necessary precondition for the detection of concealed knowledge.

The neural basis of the behavioral inhibition system (BIS)

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In the reinforcement sensitivity theory, Gray and McNaughton (2000) conceptualized the behavioral inhibition system (BIS) as the biological basis of anxiety. According to this theory, activation of the BIS leads to the inhibition of ongoing behavior, to increased arousal, and to increased attention towards the relevant stimuli. As the neuroanatomical basis of the BIS, Gray and McNaughton (2000) proposed a distributed neural network including the septo-hippocampal system. This system inhibits behavior via connections to the thalamus, anterior cingulate cortex, and prefrontal cortex. The present study investigated the relation between resting cerebral blood flow (CBF) as measured with continuous arterial spin labeling (CASL) and the BIS as measured with questionnaires. Preliminary analyses revealed a significant relation between resting CBF in the thalamus, anterior cingulate cortex, prefrontal cortex, and the BIS. This finding is in line with Gray's proposal of the neuroanatomical basis of the BIS.

Association of Common Glucocorticoid Receptor Gene Variants with Sensitivity to Glucocorticoids in Different Tissues

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A considerable variability in the sensitivity to glucocorticoids (GCs) exists between individuals. Variation of the glucocorticoid receptor (GR) gene is thought to account for part of the differences in GC responsiveness. The association between four common GR gene polymorphisms (ER22/23EK, N363S, BclI, 9beta) and markers of glucocorticoid sensitivity in three target tissues (blood vessels, immune system, pituitary) was assessed in 206 healthy individuals. Following the low dose (.25 mg) dexamethasone suppression test, male 9beta AG carriers displayed a relative non-

suppression of ACTH while no differences between genotypes were observed in women, resulting in a significant sex by genotype interaction ($p=.03$). 9beta AG men also showed the highest increase and the highest peak levels in post Dexamethasone salivary cortisol levels in the morning (main effect genotype: $p=.05$). The BclI GG genotype group showed the least degree of skin blanching, reflecting a lower GC sensitivity of subdermal blood vessels (main effect genotype: $p=.01$). No association between GR genotype and GC sensitivity of leukocytes was observed. Common polymorphisms of the GR gene were associated with GC sensitivity in sex and tissue specific manner. Variants of the GR gene might be implicated in the development of diseases related to altered GC production and sensitivity.

Women have more positive emotions in dreams than do men

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On the basis of the activation-input source-modulation model of consciousness (Hobson and Pace-Schott, *Nat Rev Neurosci*, 3, 679-93) we postulated that the brain activation during sleep is the same for both sexes. We suggested that dreams of women and men would be indistinguishable with regards to emotion. We presented 62 blinded judges with a set of 44 dreams of men and women matched for word length, from which obvious hints to the sex were removed. The judges determined the sex of the dreamer, indicated the dominant emotion and its intensity. For 55.6% of the dreams sex was assigned correctly. The statistical significance notwithstanding, a remainder of 44.4% of reports was judged incorrectly. Fear was the dominant emotion. The dream reports of women carried a threefold increase over the male reports in the incidence of the positive emotions joy and trust. Following our assumption that many dream events, characters, and emotions are synthesized de novo by the dreaming brain we are tempted to interpret our finding as evidence that joy and trust are intrinsic manifestations of activation of the female brain in sleep; an adaptation via innate readiness to emit positive emotions in the face of stimuli that evoke such response.

Retrieval-induced forgetting under stress – memory performance and cortisol level

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Retrieval-induced forgetting refers to the phenomenon that the repeated retrieval of a subset of previously learned material can cause forgetting of the nonretrieved remaining material.

However, the degree of retrieval-induced forgetting varies markedly between different subjects and conditions. The aim of the present study was to investigate to what extent retrieval-induced forgetting can be influenced by psychosocial stress.

Therefore, intervening between study phase and retrieval practice phase, subjects were exposed to either a standardized psychosocial laboratory stressor (Trier Social Stress Test; stress group) or a cognitively challenging, but nonstressful control task (control group).

Personal stress experience was validated by salivary cortisol responses acquired at different time points during the experiment and by use of mood assessment questionnaires.

No retrieval-induced forgetting effect occurred in the stress group, whereas a normal degree of retrieval-induced forgetting was found in the control group. Moreover, subjects exposed to stress showed a significant increase in free salivary cortisol and a decrease in mood.

The findings show that emotional stress abolishes retrieval-induced forgetting and suggest a causal role of cortisol due to its memory modulating effects.

Show of hands: First evidence for an influence of prenatal testosterone on anxiety disorders

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There is strong evidence that the ratio between the length of the 2nd and 4th digit (2D:4D) of the human hand is determined by prenatal testosterone and estrogen exposure in utero and that the ratio remains stable throughout life. Previous studies have found correlations between 2D:4D and several variables including sexual orientation, aggression, physical fitness, and spatial abilities. Interestingly, a number of personality traits like neuroticism and sensation seeking have been found to be related to it but so far there is no data on clinical groups. Therefore, we measured digit length of 24 spider phobic patients and 23 non-anxious control participants. There is a significant difference between groups in 2D:4D of the left hand. Spider phobic patients' left hand ratios were higher than the ratios of non-anxious control subjects. Overall, left hand 2D:4D was positively correlated with scores on spider phobia questionnaires as well as with the extent of anxiety related bodily symptoms. This pilot-study suggests that prenatal hormonal exposure may influence phobic anxiety in adulthood.

Sleep architecture and daytime wakefulness in neurodegenerative disease

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Amyotrophic lateral sclerosis (ALS) is a progressive neurodegenerative disease of the 1st and 2nd motoneurons. Breathing muscle involvement leads to respiratory insufficiency which is more significant during nighttime sleep. Eight hours nocturnal

polysomnography was conducted for three consecutive nights with 10 ALS patients. Multiple sleep latency test (MSLT) and maintenance of wakefulness test (MWT) were applied to evaluate daytime sleepiness/wakefulness at four time points during the day. We found total sleep time reduction, reduced sleep efficiency, fragmented sleep, and prolonged Stage 1 NREM sleep in all patients. REM sleep was reduced in 6 patients. Despite seriously altered sleep architecture and reduced sleep efficiency, ALS patients had no difficulties in staying awake during the day and showed only mild to moderate daytime sleepiness. The results were independent of the degree of physical impairment and ventilatory status. The little effect of a seriously disrupted night-time sleep profile on daytime wakefulness may be due to reduced daytime activity. Future studies on sleep in ALS should include anatomical and functional neuroimaging to determine whether the altered sleep architecture is due to neuronal degeneration or physical impairment. However, reports on degeneration in hypothalamus and brain stem nuclei controlling the sleep-waking and NREM-REM cycle are sparse.

Dysfunctions of the corpus callosum due to unilateral cortical lesions

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As the most important commissural fiber tract the corpus callosum (CC) connects cortical regions of both hemispheres and provides the main channel for interhemispheric transfer of information. Therefore, callosal lesions can lead to reduced conduction velocity and reliability of information. It is widely accepted that unilateral cortical lesions are associated with macro- and microstructural callosal degeneration. This study aimed to provide further support for the notion that cortical lesions can contribute to dysfunctions in interhemispheric transfer. Twenty-two patients, who underwent surgical removal of an unilateral brain tumor, as well as thirty healthy subjects were examined. Using an experimental procedure based on the Poffenberger paradigm, tactile and visual stimuli were presented to the left and right hemispheres separately. Due to the need of a hemispheric crossover of information reaction times are usually slowed, when cortical representations of the response hand and the stimulus are given in different hemispheres. This prolongation of reaction times was augmented in patients when compared to the control group. Statistical tests indicated this effect to be most pronounced with frontally located lesions in the sense of hemispheric differences.

The intensity dependent amplitude increase of the auditory evoked potential in adults with persistent attention-deficit/hyperactivity disorder

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The intensity dependent amplitude increase of the auditory evoked potential (IDAP) is related to serotonin function which is implicated in adult ADHD pathophysiology.

25 adults with ADHD (36.7y, 10f, 15m) under stable medication and 21 control subjects were presented auditory stimuli (1000Hz, 80ms) at five intensity levels (60dB to 100dB, 500 stimuli each). Patients had a WURS-K score of 42.1 and an ADHD self-rating score of 27.9. EEG was recorded from fronto-central electrodes. Trials were analysed with regard to P50, N100, P200, P50/N100 and N100/P200 amplitudes at electrodes Fz, Fcz, Cz, C3 and C4.

In multivariate analyses over intensities and electrodes we found no significant results with regard to group main effect. A group x intensity interaction was found only for the P200 component. Follow-up analyses revealed significant group x intensity effects at electrodes Fcz and C3 and trends ($p < .1$) at electrodes Cz and Fz. While the Fcz P200 amplitude in controls increased from 2.4 μ V at 60dB to 4.3 μ V at 100dB, ADHD patients showed a much lower amplitude increase from 1.6 μ V at 60dB to 2.2 μ V at 100dB.

Our study revealed an attenuation of the IDAP-P200 in adult ADHD. Further evaluations of medication effects on information processing are needed.

Effects of Early Life Stress in Psychiatric Patients

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Increasing attention has been devoted to the impact of childhood experiences on the stress system. The present study explored the relationship between early life stress and psychoendocrinological responses in psychiatric patients. The amount of stressful life events before and after puberty was examined with the German version of the Early Trauma Inventory in 76 patients with schizophrenia spectrum disorders (29), affective disorders (25), addiction (15), and borderline personality disorder (7) (48 men, age range: 18-69) and compared to 21 healthy controls (10 men, age range: 19 -70). Pre-pubertal stress load was significantly higher in patients than in controls ($p < .001$). Within the patient sample stress load was more pronounced in patients with

personality disorders and affective disorders than in schizophrenia patients ($p < .01$). Stress load within the patient sample varied with depression (BDI) and negative affect (NA, PANAS) ($p < .05$). Those patients with high NA showed a more pronounced decrease of salivary cortisol (measured three times in the hour after awakening) compared to those with low NA (AUCi: $p < .05$). Furthermore, in response to an affective picture viewing task (IAPS) patients with high stress load did not display the expected decrease in salivary cortisol response in contrast to patients with low stress load ($p < .05$).

Genetic Association Study in 6 ADHD Multiplex Families

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Attention-deficit hyperactivity disorder (ADHD) is a common neuropsychiatric disorder characterized by age inappropriate symptoms of inattention, excessive motor activity, and impulsiveness. The symptoms of ADHD appear, on average, between three and six years of age and are thought to affect 3-7% of the childhood population and 3-5% of adults. Results from family, twin and adoption studies show heritability to be around 80%. Findings from several molecular genetic studies point to certain genes involved in the dopaminergic system. Two prominent candidate genes are for example the dopamine receptor gene DRD4 and the dopamine transporter gene DAT1 (SLC6A3), localized on 5p15.33. In a sample consisting of 145 members from 6 Multiplex families, of whom 61 were diagnosed with ADHD, a finemapping project was done in chromosomal region 5p15.33-5p15.31 using 8 markers. No linkage was found between the genetic markers used and ADHD.

The randomization of trial sequences – Thoughts, problems, and solutions

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Randomization is a basic procedure in experimental design. Considering the possible consequences of it, it is surprising that, except for a few articles in parapsychological research, the topic did not receive much attention. There is neither a universal nor an exhaustive definition of randomness. Hence, any attempt to “randomize” can only be undertaken from a pragmatic point of view. Here, we distinguish between four major reasons for randomization, not all of these aims can be achieved at once, and not all of them are based on the same notion of randomness.

1. Minimization of anticipation processes, i.e. minimization of predictability.
2. Minimization of habituation effects.
3. Minimization of sequence effects.

4. Minimization of distribution effects.

Within the same paradigm, different settings in randomization may lead to different results. Our aim is to address the problems related to randomization and to provide a framework, which allows to control and communicate the parameters of randomization.

Finally, the computer program RQube is introduced which deals with stimulus sequences in a convenient and practical manner.

Building an Internet Browser for EEG Control

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The P300 Speller, a form of brain-computer interface (BCI), has been used to enable patients with ALS and other debilitating physical diseases to communicate using only their controlled biofeedback signals, recorded through EEG and manipulated using BCI2000 software. A P300 can be reliably recorded in almost all patients despite degeneration of cortical tissue. Although a P300-controlled BCI increases communication by enabling brain-wave-controlled typing, there still is a need for a similarly functioning internet browser, which could thereby enable patients to surf the web or check their e-mail, using only their P300 EEG signals as control. In this project, we have constructed a Firefox-compatible extension, Nessi, which functions as a web browser for these patients. Through Nessi, internet usage can be controlled through users' P300 signals. Nessi achieves this by combining the features of the P300 speller and the industry-standard BCI2000 with an existing Firefox extension, Hit-A-Hint, to display all links on a page with corresponding letters, which can subsequently be selected by the patient. This user-friendly program easily facilitates access to the entire World Wide Web on patients' own computers, thereby freeing limitations of simple message spelling.

Compliance with Ambulatory Saliva Sampling in the Chicago Health, Aging, and Social Relations Study (CHASRS) and the Role of Social Support

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Evidence has shown that noncompliance with given saliva sampling times in ambulatory settings can compromise resulting cortisol findings. Here, we analyzed the impact of noncompliance on the cortisol awakening response (CAR) over three sampling days in middle-aged and older adults derived from the first year of data of the Chicago Health, Aging, and Social Relations Study (CHASRS). Over the last decade, the CAR has been established as an important marker for hypothalamic-pituitary-adrenal (HPA) axis activity. Results show that subjects with noncompliant samples had a significantly lower cortisol rise after awakening at two of the three

sampling days (both $p=.01$). Social support, as measured by the ISEL, correlated negatively with the amount of noncompliant samples ($p=.046$), indicating that subjects reporting more social support had more compliant samples. These results confirm that nonadherence to saliva sampling in ambulatory settings can exert a significant impact on the resulting CAR. Furthermore, the data raises the idea that the extent of nonadherence might be systematically associated with psychosocial factors like social support. For future studies on the relationship between CAR and psychological factors, we therefore recommend controlling for saliva sampling adherence since noncompliance might be systematically associated with the phenomenon being investigated.

Interhemispheric coherence during resting state is related to interindividual differences in callosal microstructure

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The objective of the present study was to investigate the relevance of interindividual neuroanatomical differences in the corpus callosum (CC) for interhemispheric coupling as measured by EEG coherence. For this purpose the CC of 26 healthy participants was assessed by applying a combination of morphological and diffusion-tensor magnetic resonance imaging to characterize the CC on the macro- (midsagittal area) and microstructural level (mean diffusion, anisotropy). Resting state EEG was recorded during eight one minute periods (four with “eyes open” and four with “eyes closed”) using an equidistant 61-electrode arrangement. In order to obtain reference-free data the EEG was transformed by spherical spline interpolation. Interhemispheric coherence (ICoh) in the alpha frequency band (8 to 12 Hz) was calculated for homologue electrode pairs. Restricting the statistical analysis to the six electrode pairs showing a median ICoh of >0.25 , negative rank correlations between ICoh and mean diffusion were detected. The strongest association was found relating parietal ICoh (approx. P3/P4) to posterior and middle CC regions ($r = -0.43$ to -0.58). Interpreting mean diffusion as an index of microstructural tissue properties, the present results indicate that the coupling of the hemispheres is directly related to the naturally occurring interindividual variability of the CC.

Right prefrontal brain activation for intrinsic alertness measured with functional near infrared spectroscopy (fNIRS)

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Alertness is a basic psychological function within the complex psychological construct of attention. The neural basis of alertness was repeatedly found in the right prefrontal cortex. The aim of the present study was to establish the measurement of functional

brain activity during tonic alertness with near infrared spectroscopy (NIRS), an optical methods neither with any side effects nor with a highly restricting environment. Therefore we investigated in two independent samples the neural correlates of an alertness condition during which the subjects had to react as fast as possible to a cross appearing in the middle of the screen. Functional brain activity was measured with 52 NIRS channels placed over the fronto- and frontotemporal areas. Based on the results of the first sample we defined a region of interest (ROI) over the right prefrontal cortex. Within this ROI we found in the second sample significant higher [O₂Hb] and corresponding lower [HHb] during the alertness condition compared the control conditions finger tapping and passive viewing. This study underscores the involvement of the right prefrontal cortex for tonic alertness and proves the possibility to investigate the neural correlates of alertness using fNIRS.

Physiological responses and subjective ratings of panic symptoms after repeated hyperventilation

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Persons with strong fear of arousal symptoms (high anxiety sensitivity) have been demonstrated to show an increased sensitivity to symptom provocation exercises such as a guided hyperventilation challenge. Provocation tasks have typically only been employed in a single trial when studying this group of persons. To study the response to repeated symptom provocations a group of 27 persons high in anxiety sensitivity and 27 low anxiety sensitive controls were exposed to 3 guided hyperventilation trials during which startle responses as well as verbal report of panic symptoms were assessed. During all of the hyperventilation tasks, highly anxiety sensitive subjects perceived almost twice as many panic symptoms as subjects low in anxiety sensitivity. With repeated trials, both groups showed a decrease of subjective symptomatology. Startle response magnitude was also increased in high anxiety sensitive persons as compared to controls. Again, both groups showed a decrease in hyperventilation-induced startle potentiation as exercises were repeated. The results will be discussed with reference to biological and cognitive models of fear reduction.

Visual Search for Feared Targets: An ERP Study

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It has been argued that fear-relevant stimuli capture attention preattentively. Öhman et al. (2001) reports a search advantage for feared targets (spiders or snakes) compared to nonfeared targets (flowers or mushrooms). We were interested in electrophysiological differences between feared and non feared targets in a modified

visual search paradigm. As flowers and mushroom do not belong to the same category as snakes and spiders, the former categories were replaced by locusts and turtles. Subjects had to indicate whether a matrix of 4 or 9 pictures were homogenous with respect to the four stimulus classes. Half of the matrices were homogenous while half of turtle or locust matrices contained a snake or spider and half of the snake or spider matrices contained a locust or a turtle. Thus, feared targets were always presented with nonfeared distractors and vice versa. EEG was measured from 32 locations contingent on the presentation of the matrices (DC to 35 Hz, 200 Hz sampling rate).

Reaction time analysis confirmed the search advantage for feared stimuli. More positive amplitudes around 220 ms post stimulus were found at middle and right parieto-occipital electrodes for feared than for nonfeared targets. The electrophysiological data suggest that the selection advantage for the feared target is due to a less intensive disengage process from the nonfeared distractors.

Listen up! The processing of emotional sounds measured by fNIRS

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The neural processing of emotional pictures has been extensively investigated but relatively few studies have examined the processing of emotional sounds. Startle and peripheral physiological data suggest that emotional sounds activate brain areas which are known to be involved in the processing of emotional pictures (e.g., the amygdala). In addition, fMRI and EEG studies support the notion that the visual cortex is more activated when emotionally relevant pictures are presented which may be due to feedback from the amygdala to primary visual areas. Until now, there are no studies on hemodynamic changes in the auditory cortex when emotional sounds are processed.

Therefore, we presented 18 positive, negative and neutral sounds of the International Affective Digitized Sound System (IADS) to 10 healthy subjects and recorded evoked brain activation with near-infrared-spectroscopy (NIRS).

Our results show that emotional sounds elicited stronger auditory cortex activation than neutral sounds. Comparing positive and negative sounds, no differences were found regarding the amplitudes of this activation but the latencies were shorter in response to negative sounds.

This suggests that emotional information may enhance auditory processing.

Fast detection of emotional facial expressions in the left visual field

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It has been shown that perception of emotional facial expressions is lateralized resulting in more accurate categorization of emotional faces presented in the left visual field (LVF). Using eye tracking we examined if emotional faces presented in the LVF can be detected faster and if they can also be approached more quickly. We showed pairs of emotional (happy or angry) and neutral faces from the KDEF-picture set for 32ms. 28 participants were asked to look as quickly as possible to the location on the screen where the emotional face was shown. In a second block, the target was the neutral face. Eye movements were recorded and correct responses were analyzed for mean starting time of saccades directed to target positions. Reaction times were shortest for trials where emotional expressions were presented in the LVF but this was independent of the target being emotional or neutral. Faster detection of emotional expressions in the LVF does not result in specific behavioral responses to emotional targets. These results support the observation that the right hemisphere is specialized for the detection of emotional cues.

Negative Priming: Response Retrieval By Repeating Distractors?

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The negative priming paradigm requires subjects to respond to a target stimulus, which has previously been ignored as distractor. The resulting delay in reaction time is termed the negative priming (NP) effect. Accumulating evidence from neuroimaging methods suggest, that NP is correlated with neural activity in several areas of the brain, especially those that are associated with episodic retrieval processes (Steel et al. 2001). In accordance with these findings Rothermund, Wentura and DeHouwer (2005) argue that NP might be due to an automatic retrieval of incidental stimulus response associations by the repeating distractor. In this line of argumentation the repetition or switching of responses between consecutive processed displays is most critical for NP. This approach might be helpful for the explanation of age-effects in negative priming tasks. So evidence exists that older adults have a pronounced tendency to repeat previously generated responses (Kramer, Humphrey, Larish, Logan and Strayer, 1994), and, additionally, have a loss in resistance to interfering influences from prior processing compared to younger adults (Hasher, Zacks and May, 1999).

In a first step we tested 30 younger people, aiming the question whether the suggested retrieval mechanism is a general property of N tasks or occurs only under special circumstances.

Attention and the perception of illusory contours

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The role of attentional mechanisms in the perception of illusory contours (IC) has always been heavily discussed. While many published research results speak in favour of a bottom-up process, other results support the idea that IC perception demands the implication of higher-order sensory/cognitive processes. Our project aimed at investigating how attention influences the processing of IC and other shapes, by presenting the same stimuli once in a “no attention”-condition, and then in an “attention” condition.

Twenty young (18-35 years) and twenty elderly (65-92 years) healthy subjects with normal or corrected-to-normal visual acuity took part in two EEG (electroencephalography)-experiments. These experiments comprised a passive paradigm (subjects were asked to concentrate on a central fixation cross while IC-, real-contour-triangles, and non-shapes were displayed around this fixation point) and an active paradigm, in which subjects were asked to silently count the number of rare deviant stimuli (see Tallon-Baudry et al. 1997; Neuroreport, 8: 1103-7) amongst the same stimuli as were presented in the passive part. First preliminary results suggest that attention (i.e., in the case of the active, compared to the passive paradigm) enhances differential electrophysiological reactions to the different stimulus types, especially the so-called IC-effect (differential reaction between IC and non-shapes).

The impact of attentional load on the processing of task-irrelevant emotional pictures

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The present study examines to what extent the processing of task irrelevant emotional stimuli is modulated by the difficulty of a competing attentional task.

Subjects viewed a rapid serial visual presentation (RSVP) of colored unfamiliar symbols. On each trial, subjects were asked to perform an attentional task varying in load. The low load condition requires monitoring the RSVP for a specific color, the high load condition monitoring for conjunctions of shape and color. The RSVP stream was superimposed on pictures (unpleasant or neutral) from the International Affective Picture System which were always task irrelevant. To investigate selective attentional processing of pictures and task we used steady-state visual evoked potentials (SSVEPs) by presenting both of them in a flickering mode at different frequencies.

Participants detected significantly more targets and reacted faster during the low load compared to the high load task confirming that the load manipulation was effective.

SSVEPs at central occipital sites showed specific amplitude enhancement for highly arousing unpleasant pictures compared to neutral pictures. In addition, SSVEP amplitudes were found to modulate according to task demands.

The results show that emotional stimuli are preferentially processed even if attentional capacity is engaged on a concurrent demanding task.

The Attentional Network Test: Influence of irrelevant visual emotional stimuli on the orienting network

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The ANT (attentional network test) is designed to evaluate three attentional networks (alerting, orienting, execution) simultaneously, that have been defined in anatomical and functional terms. In our emotional variant of the ANT, 19 female students had to respond to a classical flanker task, where a central arrow was surrounded by neutral, congruent or incongruent flankers. These stimuli were cued with one of four different conditions at a time (1. no cue, 2. double cue: above and below the middle of the screen, 3. center cue: in the middle of the screen, 4. spatial cue: above or below the center of the screen). The flanker task appeared either in the upper or lower part of the screen. In case of a spatial cue the flanker task always appeared in the same half of the screen as the spatial cue. Instead of asterisks, that were used in the original, our cue stimuli were negative, neutral or positive pictures from the IAPS. Beside reaction times the electroencephalogram was measured from 32 electrodes and event related potentials were calculated for all combinations of cuing and flanker conditions.

Here we present the first ERP and reaction time results for the orienting network. Our analysis shows several significant main and interaction effects, but neither the evaluation of the reaction times nor the ERP analysis of different time domains shows a significant interaction between emotion and orienting. The results support the idea that emotion does not capture attention.

Stimulus expectancy modulates high frequency EEG responses

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In everyday life we often encounter situations in which we can expect a visual stimulus before we actually see it. Here we study the impact of such expectancy processes on the actual response to natural visual stimuli. Participants were to indicate the sex of deer and neat on photographs of the respective animals. On some trials, participants were cued on the breed of the following animal whereas on other trials this was not the case. Time frequency analysis of the simultaneously recorded EEG revealed cueing effects in two time windows. For validly cued stimuli, early phase-locked (approx 100ms, 20Hz) as well as late, non phase-locked (approx 300ms, 40Hz) oscillatory responses were enhanced. These findings might be related to the activity of neural ensembles that can be pretuned by expectancy to facilitate stimulus processing.

The role of attention in detection and identification of simple pop-out targets in visual search

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In our experiment we investigated whether differences can be found between simply detecting a pop-out target and identifying it, and in which processing step these differences might appear. As reaction times are only a rough measure to answer this question, we recorded event-related potentials (ERPs). There are components in the ERPs that react sensitive to the allocation of attention, as for example the N2pc. One could assume, that for identifying a single pop-out target more attention is needed than for detecting it. This difference should be reflected in the N2pc.

Regarding the early components as well as the N2pc, the results of our experiment do not show any difference between detection and identification. Such differences can only be found in the N2 and in the P3 component, which are thought as reflecting the classification of stimuli. This pattern of results suggests that for the allocation of attention it is irrelevant whether a pop-out target has to be detected or identified.

Convergence of cardiac modulation of acoustic startle (CMAS) and cardiac perception

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Baro-afferent feedback inhibits central processing of aversive physical stimuli. Accordingly, the eye blink response to acoustic startle is inhibited during the cardiac systole. This phenomenon is called "Cardiac Modulation of Acoustic Startle" (CMAS). The aim of this study was to explore if the CMAS-effect shows functional convergence with cardiac perception. We used a validated CMAS-paradigm by presenting startle probes either 230 ms or 530 ms after the actual R-Spike depicted from standard ECG. 40 randomized startle probes were presented to each of 30 volunteers and, in addition, the participants performed a modified Whitehead- and a Schandry- cardioception task. The Whitehead paradigm was based on R-Spike-stimulus delays of 230 and 530 ms. During the Schandry task, participants were asked to count their own heartbeats quietly over a period of 30, 45 and 60 seconds. The CMAS-effect was present ($p < .01$). The Whitehead- and the Schandry-performances did not correlate significantly ($p > .1$). The CMAS-effect correlated significantly ($r = .60$; $p < .01$) with interoceptive performance of the Schandry-task. We conclude that CMAS and standard cardiac perception tasks may share common variance, suggesting involvement of similar or converging processes.

Evidence of aversive conditioning during assessment of prepulse inhibition of acoustic startle

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Prepulse inhibition of startle (PPI) represents an automatic mechanism reflecting sensory motor gating and attention processes. PPI is thought to be neither due to conscious behavioural inhibition nor depending on learning or conditioning. However, general considerations and two basic forms of associative learning (delay- and trace-conditioning) rise up the question whether the prepulse represents a conditioned stimulus (CS) in standard PPI-paradigms. Thus, we tested eyeblink responses (via EMG) to various weak acoustic stimuli and intense acoustic startle stimuli in 28 participants. Stimuli were either presented alone or in prepulse-startle stimulus pairs (SOA=120 ms). We found that after contingent pairing of prepulses and acoustic startle stimuli (PPI-paradigm) intense versions of the prepulses induced higher startle eyeblink responses than control stimuli. Thus, the prepulse represents a CS in standard acoustic paradigms investigating PPI of startle.

The human brain extracts personal significance of an auditory stimulus preattentively

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When the acoustic environment is ignored, the occurrence of unexpected sounds is detected automatically by the brain. Long-term memory traces affect this automatic deviance detection and involuntary attention system, usually reported in group-approaches in the domains of speech, music and environmental sounds. We addressed the question whether even personal significance of a sound is extracted automatically and to what extent the processing of this sound is qualitatively and chronometrically different compared to a non-significant sound. In a two-deviant passive oddball paradigm we presented one's personal relative to another person's ringtone. Analysis of event-related potentials (ERPs) revealed additionally to the usual Mismatch Negativity (MMN) and P3a component, elicited by deviants in contrast to standard stimuli, a posterior ERP directly following MMN for the personally significant deviant only. This specific impact of personal significance started around 200 ms after sound onset and involved neural generators that differed from the mere deviance detection mechanism. Enhancement of P3a to the personally significant deviant followed by a widely distributed deflection for this deviant only, suggests that the own ringtone was more powerful to attract attention involuntarily and that this stimulus might have evoked further analysis involving evaluation of relevance or reorienting to the primary task.

The effect of stimulus predictability on the Mismatch-Negativity. An ERP-Study

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The Mismatch Negativity is an auditory event related potential elicited by infrequent deviants in a row of standard tones. Results from previous studies investigating the predictability of stimulus deviation reported inconsistent results. Here we aimed to examine the sensitivity of the MMN to modulation in deviance predictability.

ERPs were recorded from 29 subjects (8 male; age 25.38 [sd=4.427]). While watching a silent movie, subjects were presented two vowel-like stimuli (80ms duration, SOA 500ms) with standards only (STD), and STDs with regular and irregular deviants (MMNreg/MMNirreg, each 12%). Here we investigated MMN peak amplitudes and latencies at FCz where MMN was largest.

We found increased FCz amplitudes in the irregular condition (-5.662 μ V; sd = 2.099) as compared to the regular condition (-4.808 μ V; sd = 1.608, $r=.803$; $p\leq.01$). A pairwise comparison shows significant differences in FCz amplitudes over the 3 conditions. Tests of within-subjects effects shows an condition*tone interaction in latencies ($F(2/18.789)=5.241$; $p\leq.033$).

Our results demonstrate that predictability of auditory deviance modulates MMN amplitude. While MMN may be elicited with any form of deviance within the time frame of the auditory sensory memory trace, predictability additionally modulates it's amplitude. Furthermore, condition and tones may influence the auditory perception and processing.

The effect of stimulus predictability on the Mismatch-Negativity. An fMRI-Study.

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The Mismatch-Negativity (MMN) is an event-related potential component, elicited by infrequent deviant tones presented among a series of frequent tones. Imaging studies found MMN-generators in the vicinity of the auditory cortex, but the existence and function of prefrontal generators remains unclear. Here we aimed to investigate the modulation of deviance predictability on MMN-sources.

22 subjects (age 25.8 [sd=4.5], 8 male) were scanned with sparse functional MRI: 1.5T, TR=1.8 sec, TE=54ms, FoV=23cm, 64x64 voxel, 18 slices, 5.5 mm. While watching a silent movie, subjects were presented two vowel-like stimuli (80ms duration, SOA 500ms) with standards only (STD), STD with regular and irregular deviants (MMNreg/MMNirreg, each 12%) and a Quiet baseline condition.

In both MMN contrasts, temporal activations shifted posterior to the temporoparietal junction as compared to the STD/Quiet contrast. In the direct comparison of unpredictable and predictable deviants we found activation in the left superior

temporal gyrus, the right middle temporal gyrus and the right precuneus at $p < 0.0001$.

The direct comparison of both MMN conditions revealed activation at the temporoparietal junction and the precuneus related to stimulus unpredictability. Predictability in auditory change detection seems to be related mainly to the temporal generators of the Mismatch Negativity.

Postersession II

Is pop-out detection in visual search preattentive?

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Pop-out detection is often considered fast, spontaneous and preattentive. In most visual search studies, however, attention is focused on the search task and observers respond to the pop-out stimuli. The present study investigated pop-out search also under restricted attention conditions: when search displays were a) not attended and not task-relevant, b) attended and task-relevant, and c) could be attended but were not task relevant. Event-related potentials (ERPs) were recorded for color and orientation pop-out targets and in target absent trials. We observed an N2pc only when stimuli were attended and task-relevant. For attended pop-outs, the N2pc was more pronounced for color pop-outs than for orientation pop-outs, indicating that saliency may have modulated the attracting of an observer's attention. However, results showed no evidence for preattentive processing of pop-outs when they were not attended and not task relevant.

Examining Strategic Adaptation in the Eriksen Flanker-Task using Brain Potentials

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In this study, we examined adaptation of selectivity of information processing (selective attention) with event-related brain potentials. Using Eriksen-Flanker-Task version, subjects are presented with a visual display composed of three arrows. Subjects have to make a quick discriminating response based on the central arrow. The other arrows are distractors. Although distractors are task-irrelevant, it can be found that task performance is decreased if distractors suggest another response than the target (conflict condition). It has been shown that this flanker interference can be modulated by various manipulations. For instance, flanker interference is reduced in task blocks with higher frequency of conflict. Current models of cognitive control interpret this modulation by conflict frequency as adaptation of the cognitive system. Information processing becomes more focussed. We examine the effects of conflict frequency on the fronto-central N2, an ERP component that has been used as an indicator of response conflict. N2 amplitude is found to be enhanced in conflict trials but this enhancement is less pronounced in task blocks with high frequency of conflict. This pattern of results is in agreement with the more focussed processing of the central target hypothesis.

Don't touch me when I'm busy! Impact of distractors upon voluntary spatial attention in somatosensation

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As of today neuronal mechanisms that underlie the interaction of voluntary and involuntary attention in the somatosensory system are not well understood. Here we investigated the influence of transient events upon ongoing vibrating stimulation in a spatial attention task. We stimulated the left and right index finger over several seconds mechanically with 30 and 34 Hz, respectively, that elicited the somatosensory steady state evoked potential (SSSEP).

Concurrently we recorded somatosensory event-related potentials (SEPs) to the embedded targets and distractors.

An attention-directing cue indicated which finger subjects had to attend to and to detect targets. Targets (and distractors) occurred in 17.5% of all trials.

Behavioral results showed correct responses about 90%, indicating relatively low task demands. Neural responses showed the vibratory stimulation evoked a SSSEP with a contralateral frontal focus. Any event at one hand resulted in a significant suppression of SSSEP amplitude at the opposite hand. The SEP showed a significant decrease of the N140-component and an increase of the late positive component for targets compared to distractors. This pattern of results indicate that regardless of spatial voluntary attentional control, events at the to-be-ignored hand involuntarily pull attention towards that body side. Whether or not this effect is only due to the relatively easy target detection task is subject to our future studies.

Event Related Skin Conductance Responses as an Indicator for Attentional and Emotional Processes

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As several studies have shown meaningful stimuli elicit enhanced skin conductance responses (SCRs). Especially emotional stimuli are considered to be a priori meaningful even when selective attention is guided by a task demand.

In the present experiment one group of participants was instructed to count pictures from the IAPS containing a specific feature. Besides these task relevant stimuli – and additionally task-irrelevant neutral stimuli – emotional pictures served as distractors. The same pictures were, in absence of the counting task, presented to a second group of subjects.

The results revealed increased SCR magnitudes for task relevant stimuli whereas the emotional pictures elicited comparable SCRs to neutral stimuli. This missing dissociation between emotional and neutral pictures persisted also when the task was absent.

On the one hand these findings illustrate that the task demand is a suitable instrument for capturing attention and on the other hand the consistent results for

emotional and neutral stimuli show that the emotional pictures are possibly not meaningful enough to serve as appropriate distractors.

Does the emotional content of T1 stimuli modulate the Attentional Blink effect?

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When two targets must be identified in a rapid serial visual presentation (RSVP) paradigm, perception of the second target (T2) is impaired if it occurs 200-500 ms after the first target (T1), a phenomenon labelled as “Attentional Blink” (AB). In previous studies it could be demonstrated that emotional and threatening T2s following neutral T1s reduced magnitudes of the AB effect. The present study examined, whether spider phobic and control subjects show a modulated AB effect when T1 is threatening, emotional or neutral.

Subjects (12 phobics, 14 controls) had to identify two targets among distractors in a RSVP task, while the EEG was recorded. T2 pictures were neutral, whereas T1 was either a neutral, positive (two categories: babies or animals), negative (casualties) or a spider picture.

As compared to trials with neutral T1s the AB was significantly increased when T1 was a negative or a positive (animal) picture. However when T1 displayed a baby the AB effect was slightly reduced, which indicates that face processing in humans is highly automated. Surprisingly the AB effect did not vary between phobics and controls in trials where T1 showed a spider. These findings and the results of the event-related potential analysis will be discussed.

Attentional modulation of psychophysical tuning curves for direction of motion

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Competing mechanisms have been proposed to account for the effects of attention on visual information processing, namely enhancement of the processing gain vs changes in the selectivity, ie the width of perceptual filters. Here, we used a psychophysical variant of the motion reverse correlation (MRC) method in a dual-task paradigm to investigate the effect of attention on the selectivity for motion direction. The stimulus consisted of an eccentrically presented random sequence of fully coherent, rapid motion impulses in various directions. Subjects were required to press a key each time they detected a designated target direction. Every subject performed the motion detection task under two conditions, differing in attentional load (high vs low) of the concurrent second task. By reverse correlating behavioral responses with individual motion impulses, we obtained Gaussian-shaped direction-tuning curves for each attentional condition. Comparing amplitude and width of the

tuning curves across the two attention conditions revealed that attention leads to an increase in amplitude of about 10%, and a decrease in width of about 6%. These results demonstrate that attention can narrow the width of the perceptual filter, which might indicate an increase in the selectivity of the neuronal population response to motion direction.

Audio-tactile integration of meaningful objects in the human brain

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Functional imaging studies of audio-tactile (AT) processing revealed caudal auditory belt areas as the prime candidate region for AT integration (Foxy et al., 2002; Kayser et al., 2005; Murray et al., 2005; Schuermann et al., 2006). However, these studies employed rather low-level stimulus material. Here, we used fMRI to test for AT integration of meaningful natural objects (animals). While controlling for potential cue and motor confounds using a 'no-stimulus' baseline condition (M), we searched for regions that were activated by each of the unimodal conditions (i.e., $A > M$ as well as $T > M$), and additionally responded more strongly to bimodal AT stimulation than to each of the unimodal conditions. Although tactile stimulation was restricted to the right hand, we were able to reveal a bilateral temporo-parietal region located between the secondary auditory and somatosensory cortices. Motivated by recent findings on audio-visual (AV) integration in potential homologue regions of the non-human primate (Kayser et al., 2007), we further tested this region for audio-visuo-tactile (AVT) integration. However, employing strict criteria for AVT integration we neither found the $V > M$ nor the $AVT > AT$ criteria to be fulfilled. We thus conclude that the integrative role of this bilateral temporo-parietal region might be specific to AT integration.

What's so funny - Rat 50-kHz vocalizations as an ancestral form of human laughter?

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Panksepp and coworkers have provided a wealth of experimental evidence showing that rats, if tickled in a playful way, emit 50-kHz chirps. Even more, these rats became socially bonded to the tickling experimenter, could be conditioned to seek tickles, and preferred to spend more time with other animals that chirped a lot rather than with those that did not. Based on such evidence, Panksepp suggested that „rat laughter“ might serve as an index of the animal's subjective state, and that it might provide a new measure for analyzing natural reward/desire circuits in the brain (Panksepp Science 308'05). We have recently shown that 50-kHz calls cannot only be induced by tickling rats, but also by shortly isolating them from their mates in a

housing cage (Schwartz et al. Behav Brain Res in press). Calling under such conditions did not habituate with repeated testing, and occurred in the animal's own, or in a fresh housing cage. Furthermore, the propensity to call differed substantially and reliably between individual rats. We assume that such calls are social signals (for example, to re-establish contact), which are more likely if the animal is in a positive emotional and appetitive state. New evidence in favor of this hypothesis will be presented.

Probing category selectivity to environmental sounds in the human auditory cortex

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Despite some recent advances, cortical representations of auditory stimulus categories have generally remained elusive. Here we employed an fMRI-adaptation paradigm to identify subregions in non-primary auditory cortex responding preferentially to auditory stimuli from the categories 'tool sounds' or 'animal vocalizations'. We consecutively presented pairs of sounds with either same or different identity/category. Within the bilateral superior temporal gyrus (STG), we observed significant adaptation effects irrespective of stimulus category. Moreover, portions of the left STG showed a stronger fMRI signal for the presentation of different compared with identical tool sounds (adaptation to tool sounds). In contrast, although the response profile of left posterior middle temporal gyrus (pMTG) suggested a general sensitivity for tool sounds (in comparison to animal vocalizations), no adaptation effects for the repetition of the same tool were detected in this cortical region. Thus, pMTG might only be sensitive to tool sounds as such. In sum, our findings suggest a representation of the spectro-temporal feature of different categories in bilateral STG. However, particularly salient and action-related stimuli such as tool sounds might already evoke differential processing on a level as early as left STG. Finally, more specialized processing of tool-related sounds could be associated with left pMTG.

Precise forward-modelling in the auditory cortex

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Precise forward model mechanisms were suggested for discriminating the sensory consequences of one's own actions from those of others. Based on a match between predicted and actual sensory consequences, upcoming self-generated sensations could be attenuated or even cancelled out. By contrast, externally generated signals cannot be accurately predicted by the forward model.

We studied the precision of such forward processes in the auditory cortex with human electroencephalography (EEG). In a self-initiated task, the participants were asked to initiate tones through pressing a button. In an externally-initiated task, tones were presented that were identical acoustically and in timing. In 2x2 design, the frequency of the sounds was either fixed (predictable) or variable (unpredictable). Moreover, the time of presentation of the sounds varied as well (predictable vs. unpredictable).

Our data clearly showed an attenuation of the N1 response for self-initiated sounds compared to externally initiated tones in all conditions. Furthermore, differences between the conditions could be observed indicating strongest attenuation of the N1 for predictable frequencies.

Thus, our data support a forward model mechanism in the auditory domain. This forward mechanism operates effectively even when the consequences self-initiated actions, like the frequency of the sounds or the time of presentation, are unpredictable.

Position-invariant representation of natural sounds in the human auditory cortex

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Successful interaction with our environment entails both efficient identification and localization of auditory objects. Recent neurophysiological studies proposed a dual-path model in which auditory identification and localization follow anatomically distinct routes within the cortex. In the present study, we employed an fMRI-adaptation technique to test the form of representation along the auditory processing stream. To this end, we presented subjects with pairs of animal vocalizations with a) same identity and same position, b) same identity and different position, c) different identity and same position and d) different identity and different position. While performing a same/different identity judgment, subjects showed significantly stronger fMRI responses for different versus same identity in the left Heschl's gyrus (HG), the left planum temporale (PT) and the bilateral superior temporal gyrus (STG). Significantly stronger fMRI responses for different versus same position were observed in the left posterior STG only. These results suggest position-invariant representation of auditory object identity in the left HG, PT and the more anterior aspects of the STG, but position-dependent representation of auditory objects within the left posterior STG.

Assessment of driver's mental state using EEG spectral analysis in a field study

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Several approaches for the assessment of cognitive processes have considered EEG spectral analysis (Basar et al., 2001). Here we present a feasibility study which investigates its potential to assess differential mental states during auditory information processing as it is required by several driver assistance systems. We hypothesised the alpha band being a promising candidate. It is thought to be the most robust measure with respect to artefacts elicited by the driving situation (motion artefacts - gamma band, eye movements and blinks - theta band). We selected a route which included stages along a highway and within the city. Driving instruction was given verbally taking the current traffic situation into account. For a general feasibility screening we compared attending to the verbally given driving instructions against a baseline for each frequency separately. When the driver was attending to the instructions we observed a global suppression in the alpha (7-12 Hz) band as well as an increase of power in the Gamma Band at central and parietal electrodes around 40 Hz. From our pilot study we conclude that EEG spectral analysis can be a valid measure to assess differential mental states during auditory information processing.

EMGpeakfind - A MATLAB-toolbox for scoring startle eye-blink, and other EMG data

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There are now a number of published standards on how to score EMG-data but no universally accepted method. Computer programs for this specific purpose are rare. Here we introduce EMGpeakfind, a MATLAB-toolbox for scoring startle eye-blink, voluntary, and spontaneous EMG reactions. The program classifies events simultaneously in the raw-EMG and two filtered, rectified signals. For the latter, the signal can be smoothed with short (latency measures) and long (amplitude measures) time-constants. Events are identified by stepwise application of increasingly stringent criteria implementing established and new algorithms. The best possible solution is saved after visual control. Additionally, results for each step are available for comparing different criteria. Saved data output includes latency and magnitude for minimum, peak, and foot-points at beginning and end of reactions. Additionally, different baselines and control scores are available. Custom settings can be conveniently predefined in a text file and selected at program start. Event tagging and quality ratings can be used to filter results for further analyses. EMGpeakfind combines the advantages of established and new algorithms, and allows for a comparison of different scoring strategies. Its modular design supports

flexible integration within other MATLAB programs, while a graphic user interface provides stand-alone functionality.

A simple automatization procedure for the removal of blink artifacts by independent component analysis

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Ocular artifacts still represent a serious artifact source in psychophysiological (EEG-) research. Hence numerous procedures have been developed to overcome this problem. Recently, one approach is drawing increasingly attention: Independent component analysis (ICA), which has been shown repeatedly to be a reliable method for the removal of artifacts from the EEG. However, one drawback of the procedure is, that manual inspection of the decomposition is required to identify components representing ocular artifacts (e.g. by time-course of activation or topography). Hence, the procedure appears to be more time consuming than classical regression based approaches. There have been only few, rather complex attempts to automate the procedure. The present study proposes a simple, but reliable approach, which combines independent component analysis, automatic blink detection and classical regression measures. This approach can be implemented easily into already available software packages.

Decomposition of electrodermal responses - is that necessary?

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Overlap of subsequent electrodermal responses in psychophysiological experiments may be due to short interstimulus-intervals or to spontaneous electrodermal activity. The conventional trough-to-peak measurement of amplitudes inevitably leads to an underestimation of the subsequent response. Newer scoring methods, especially decomposition and deconvolution procedures, aim at overcoming this problem and have already been applied in clinical studies.

Here, a decomposition method is compared to the conventional trough-to-peak scoring. First, a theoretical, model-based estimation of scoring differences under varied interstimulus intervals and varied amplitude ratios of two subsequent electrodermal responses is presented. Second, both methods are compared using data from a lie detection study with seventy-three participants where electrodermal responses frequently occurred pairwise with a four-seconds onset asynchrony. Comparison is shown on a single-trial basis as well as on the basis of study results. Further considerations suggest to prefer the newer, more complex methods in studies using interstimulus intervals below about eight seconds.

Skull thickness and EEG alpha power

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Electroencephalographic (EEG) research on the physiological basis of individual differences in personality or intelligence commonly presumes that between-subjects differences of EEG amplitudes reflect individual differences in brain functions. However, non-functional sources of variance such as individual differences in skull thickness may significantly contribute to individual differences in EEG amplitudes. Aim of the present study was to assess the association between skull thickness and EEG in the alpha band.

A 58-channel EEG was recorded from 29 subjects in resting states at three occasions of measurement each 5 weeks apart. The EEG data were aggregated across all occasions in order to increase the trait specificity of the data. Skull thickness was assessed with proton-weighted images of the head that were acquired with a 1.5 T magnetic resonance imaging (MRI) scanner. There was no significant association between EEG alpha power at various sites and the thickness of the underlying skull, with correlations ranging between $r = -.34$ and $r = .10$. This finding suggests that skull thickness may be neglected as a substantial source of error.

Neural efficiency and resting cerebral blood flow

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According to the neural efficiency hypothesis of human intelligence, more intelligent individuals use their brains more efficiently to solve cognitive tasks (e.g. reasoning, problem solving or working memory tasks). There has been a large body of evidence for this hypothesis based on studies applying different research approaches (e.g. EEG, PET, SPECT, MRI and fMRI). This study investigated the relation between resting cerebral blood flow (CBF) measured with continuous arterial spin labeling (CASL) and performance in attentional and working memory tasks in 18 healthy subjects between 60 and 70 years. Consistent with the neural efficiency hypothesis, a negative relation was found between resting CBF in whole brain matter and cognitive performance (especially in a tonic alertness task). This finding is in line with previous evidence and supports the neural efficiency hypothesis.

The role of sexual orientation in the perception of facial expressions of emotion

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It has been demonstrated that the perception of facial expressions is modulated by sexual orientation. Contrary to men, the border between hetero- and homosexuality in women may be more blurred. The present study aimed to more closely examine the relationship between sexual orientation and the perception of facial expressions of emotion. Therefore, 20 female participants (age 19 - 38) viewed male and female emotional facial expressions in two consecutive blocks, while the startle reflex, heart rate, and skin conductance responses, as well as subjective ratings and recognition accuracy, were recorded. The participants described themselves as either heterosexual (N = 10) or bisexual. The subjective ratings of the emotional facial expressions revealed no group differences. However, after controlling for effects of the random block design, results indicate that bisexual women showed stronger overall skin conductance responses to facial expressions regardless of the gender of the sender or emotional content, while heterosexual women were sensitive to emotional content ($p < 0.01$, partial-eta-square > 0.25). There were no group differences in recognition accuracy, social anxiety, or state and trait anxiety. The results of this pilot study indicate that sexual orientation modulates autonomic reactivity to facial expressions of emotion.

Trait Anxiety Modulation of the Neural Responses to Automatic and Elaborated Processing of Threat-Related Pictures

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Processing of threat-relevant information in trait anxious individuals is characterized by biased attentional and evaluation mechanisms. The neural correlates underlying trait-specific forms of emotional-cognitive interaction are not well understood yet. Using fMRI, we investigated effects of trait anxiety on BOLD-signal changes during explicit and implicit emotional processing of threat-related versus neutral pictures. Thirty-eight healthy volunteers, pre-selected on the basis of their scores on a trait index aggregated across two anxiety scales and two occasions of measurement, participated in this study. Both, the explicit and implicit task induced stronger neural responses to threat-related versus neutral pictures in the amygdala, anterior cingulate cortex (ACC), dorsomedial prefrontal cortex, and insula. Most importantly, specific interactions between information processing modus and trait anxiety were observed. Higher levels of trait anxiety were associated with relative signal increases in the insula during the explicit condition only, whereas moderate levels of anxiety predicted augmented signal intensity of the dorsal ACC during the implicit condition. These findings indicate that trait anxiety may interact with attentional focus to

determine brain responses to threat-related information. Furthermore, our results suggest that activation in the insula and ACC might represent main mediators of individual differences in the anxious phenotype.

Comparing Indices of Sympathetic Activation: Pre-Ejection Period and T-Wave Amplitude

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Both a shortening of the pre-ejection period (PEP) and an attenuation of the T-wave amplitude (TWA) have been used in psychophysiological research as indices of sympathetic activation.

We compared the suitability of the parameters to detect changes of sympathetic activation during pharmacological stimulation.

We assessed 40 healthy volunteers. One hour before the recordings, a venous catheter (22G) was placed into the cubital vein. PEP and TWA were calculated from ECG and impedance recordings.

After baseline measurements, 20 subjects received an infusion of first 30 ng/kg/min and then 60 ng/kg/min epinephrine for 5 minutes each. The 20 subjects of the control group received saline solution only. The infusions were controlled from the adjacent room.

An ANOVA with repeated measures design revealed a significant attenuation of the TWA ($p < 0,001$) as well as a significant shortening of the PEP ($p < 0,001$) by epinephrine infusion. During low-dose infusion of epinephrine, PEP shortening reached a higher level of significance ($p < 0,001$) than TWA attenuation ($p = 0,042$). The effects size (partial Eta square) was larger for PEP (0,85) than for TWA (0,41).

We conclude that the shortening of the pre-ejection period is a more sensitive marker for sympathetic activation than the attenuation of the T-wave amplitude.

Compliance with ambulatory saliva sampling protocols: Interventions to improve compliance and effects of noncompliance on cortisol daytime profiles

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Studies illustrate that noncompliance with ambulatory saliva sampling protocols results in invalid cortisol daytime profiles. Currently, the most effective intervention to enhance compliance is to inform participants that their sampling behaviour will be monitored by electronic devices. The goal of this study was (a) to investigate less elaborative interventions to improve compliance and (b) to test the effects of noncompliance on cortisol daytime profiles with a large sample.

119 students (63 women and 56 men) aged 18 to 35 years were assigned to four groups—bar code label, clock, information, and control group (non-informed). Participants collected five saliva samples throughout one day in their natural environment.

73% of participants complied with the protocol. The informed group showed less mean time deviation from the target sampling times compared to the non-informed group ($U = 265,500^{**}$; $p = 0.010$). The non-informed group and the two other groups did not differ. A repeated-measures ANOVA of the circadian cortisol profiles revealed no significant difference between the compliant and the noncompliant group. Informing the subjects about electronic monitoring devices is still the most effective intervention to improve compliance. A large subject sample seems to be a possibility to reduce data bias caused by noncompliance.

Effects of Genetic background, maternal care and sex on isolation-induced calling in mice pups: A uterine-transfer study”

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C57BL/6NCrl (B6N) and C57BL/6JOlaHsd (B6J) mice differ in their adult anxiety-related behavior. Such differences are likely explained by genetic differences between strains. However, environmental factors have proved to hold strong epigenetic influence on the development of anxiety. Especially, maternal care is a critical factor. Here, we tested whether differences between both strains are already detectable during infancy by using isolation-induced ultrasonic vocalizations as a measure for anxiety. To dissociate between genetic background and maternal care, blastocysts of each strain were transferred to pseudo-pregnant females either of the same or the other strain. Results show that call number differed dependent on the strain of the mother, since pups raised by B6J emitted more vocalizations than those raised by B6N. Furthermore, pups raised by mothers of the same strain emitted more calls than pups raised by mothers of the other strain. However, call features differed between pup strains, e.g. peak frequency was higher in B6J than in B6N irrespective of the strain of the mother. Finally, sex had comparably weak effects on calling. In short, the amount of isolation induced calling is primarily the result of an interaction between mother and pup, whereas call features are primarily related to the strain of the pup.

Social anxiety modulates the startle response to chemosensory anxiety signals in humans

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People suffering from social anxiety show an enhanced reactivity to social cues. Chemosensory signals are potent sources of social information, and socially relevant emotions are often communicated via chemosensory signals in animals. In humans, chemosensory anxiety signals have been shown to augment the startle reflex. In this study, we investigated whether socially anxious individuals show an enhanced startle response to chemosensory anxiety signals. 69 (35 male) persons donated axillary sweat both before taking an important oral examination at the university and in a sport situation. In two experiments, 16 socially anxious and 30 non-anxious participants were exposed to the chemosensory signals using a constant flow olfactometer. Detection rates, subjective ratings, the startle reflex to an acoustic probe and the skin conductance response were assessed. Detection rates for the chemosensory signals were 34% for the non-anxious and 21 % for the anxious participants. Results indicate that especially in the socially anxious group the startle reflex was augmented through chemosensory anxiety signals ($p < 0.01$). The skin conductance response did not show any effects. It is assumed that a general hyperreactivity to social cues in social anxiety accounts for the current results. This study was supported by the German Research Foundation (DFG: PA 937/1).

Sex-specific changes of autonomic/sympathetic nervous system stress reactivity with increasing age

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Over and above numerous findings about stress responses of the hypothalamic-pituitary-adrenal axis to acute stressors, there are few data about sex-specific changes of autonomic/sympathetic nervous system stress reactivity with increasing age. Several new studies indicate salivary alpha-amylase (sAA) as a surrogate marker of this component of the psychobiological stress response. While sAA has been shown to rapidly increase in response to psychosocial stress, possible influences of sex and age on these responses have not been reported so far. Data from two independent studies using the same stress paradigm were reanalyzed to examine the impact of age and gender on sAA responses to this standardized psychosocial stress task (Trier Social Stress Test; TSST) in 69 younger adults (mean age: 24,0 yrs.) and 44 older adults (mean age: 60,5 yrs.). After controlling for individual stress-ratings there was an age-related decline in the sAA stress response ($p = .002$) with younger adults showing significantly higher sAA responses than the elderly ($p = .037$). For the total group no main effect for sex on sAA was observed. However, a significant sAA x age x sex interaction appeared

($p=.007$). The analyses showed that there was no sAA response difference between younger and older men. Younger women, however, had a higher sAA stress response than older women ($p=.007$) which was also higher than in the group of young men ($p=.041$).

In sum, this reanalysis revealed differential sAA stress responses in younger and older men and women. Since no experimental data are available to date, it can only be speculated that sex steroids, especially estradiol, may play an important role in moderating these changes.

The influence of psychosocial stress on semantic memory

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The stress induced increase in glucocorticoids is known to modulate memory. Studies in humans show that stress has detrimental effects on episodic memory retrieval whereas, at the same time, it enhances memory consolidation. Both effects are more pronounced for emotionally arousing material. Whether a similar effect of stress occurs on semantic memory is yet to be investigated. Therefore forty young male participants were exposed to either a psychosocial stressor (Trier Social Stress Test) or a control situation. Subsequently, retrieval of semantic memory was tested. A category-fluency task consisting of both a neutral and a negative category was used. In addition, participants completed a second verbal semantic task. The stressor induced an increase in salivary cortisol as well as an increase in negative mood. A significant stress by arousal interaction was detected for the category fluency task. After stress exposure, retrieval of negative category members was reduced in relation to retrieval of neutral category members. No effect of stress was observed for the second semantic memory task. The findings suggest that stress impairs semantic memory retrieval of negative material while neutral material is not affected. This observation mirrors our previous results on the effects of stress on episodic memory retrieval.

Oculomotor response switching in schizophrenia patients

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Poor antisaccade performance is a reliable index of neurocognitive dysfunction in schizophrenia. The task requires to look away from a sudden-onset visual stimulus and schizophrenia patients are impaired in suppressing a reflexive glance toward the stimulus. Recent studies showed that the deficit is enhanced if two successive trials require antisaccades to opposite directions. This response switch effect suggested interference of both response programs and impaired selection of the new response. Because antisaccades are complex responses that may include inhibitory processes,

the current study tested whether interference would also show up if the preceding response is a simple volitional saccade. 15 schizophrenia patients and 15 healthy control participants executed sequences of one to three volitional saccades to the same direction. A subsequent test trial required either another response repetition or a response switch, both with distracters on the respective opposite side. The results confirmed a response switch deficit in schizophrenia patients but only if the prior response program was strengthened by three response repetitions. The data are compatible with the notion of a response selection deficit in schizophrenia patients, which may only show up on conditions of high response conflict.

Loss or severe illness of a significant other during pregnancy is associated with depression, fatigue, pain and gastrointestinal disorders in the adult offspring

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BACKGROUND: In Germany, an increase in stress-related ailments ("psychosomatic disorders") is observed, which constitute a considerable burden for the individual and society.

The etiology of such ailments however remains widely unknown. The "fetal origin" hypothesis put forth by Barker in 1993 posits that the organisms' proneness to stress-related disorders may largely be determined as early in life as in the prenatal period, during brain maturation. Accumulating evidence in animal and human research indicate that prenatal stress exposure may thus predispose to the development of stress-related disorders throughout the life course.

METHOD: 350 subjects born during the time of World War II resp. shortly thereafter completed a battery of psychological and medical questionnaires. Prenatal stress was assumed when subjects reported loss or severe illness of a significant other during their mother's pregnancy.

RESULTS: Reports of prenatal stress were associated with significantly higher scores in depression, fatigue, pain symptoms and a tendency towards a higher prevalence of gastrointestinal disorders.

DISCUSSION: Dysregulations of the hypothalamus-pituitary-adrenal-axis are discussed as a putative mediator.

Attentional bias to smoking cues and reward learning in nicotine dependence

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Acute nicotine consumption stimulates the release of dopamine in the brain-reward-system. The involved mesocortico-limbic pathways play a central role in incentive

motivation and the development of addiction. PET-studies have shown that repeated nicotine consumption causes a sensitization of the effects on dopamine overflow and leads to a reduction of the number of dopamine-D2-receptors in the nucleus accumbens. These neuronal changes lead to the experience of craving, which includes an increased sensitivity for smoking cues. At the same time, the reduction of the dopamine-D2-receptors is related to a decreased sensitivity for natural reinforcers.

Aim of our study was to test the assumption of an impaired reward-related behavior in dependent smokers. More specifically, we expected a substance-related attentional bias to nicotine-related stimuli and a reduced performance in reward learning with natural reinforcers. We compared smokers to a matched control group of non-smokers in tests of attentional bias and reward learning. Smokers were classified as nicotine dependent (using the DSM-IV criteria) or occasional smokers. Attentional bias to nicotine-related stimuli was assessed using the emotional Stroop paradigm. Reward learning with natural reinforcers was assessed in a probabilistic classification learning task.

Toward an auditory ERP speller

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Studies showed that event-related-potentials based BCIs can be used for communication in individuals with severe degenerative neuronal diseases such as amyotrophic lateral sclerosis. However, considering the rapid disease progression, patients' ability to control eye muscle activity may decrease substantially.

We propose an auditory event-related-potential BCI spelling system. This system is simulating a 5x5 matrix containing the letters of the alphabet. The rows and columns are auditorily coded by numbers from 1 to 10. Selection occurs by attending those stimuli which are corresponding to the coordinate of the target letter in the matrix. Fifteen healthy participants took part in 3 to 6 run sessions on two days and their task was to spell the word BRAINPOWER. Six subjects achieved an accuracy above 70% which is the criterion level for spelling. Selection time per letter could be reduced from 15 to 8 sequences. Compared to visual ERP BCIs both amplitude and latency of the P300 to the target stimuli appeared to be increased; a processing negativity superimposes the P300 response of the ERPs. These results indicate that an auditory ERP-BCI can be used for communication. Whether such a BCI will be feasible for paralysed patients awaits investigation.

EEG-controlled brain-computer interfaces in paralysed and healthy participants

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Over the past 12 years 36 patients, mostly diagnosed with amyotrophic lateral sclerosis in different stages of physical impairment and about 100 healthy volunteers were trained to control a brain-computer interface (BCI) at our institute. Slow cortical potentials (SCP), sensorimotor rhythms (SMR), and event-related potentials (ERP) were used for BCI-control. Provided with visual or auditory feedback, about 75% of all participants learnt to control a BCI. Healthy volunteers learnt faster than patients, but no differences in achieved accuracy was seen. Visual feedback allowed for faster learning than auditory feedback. Accuracy levels of above 80% correct responses were obtained with all BCIs. To achieve control of the SCP- and SMR-BCI was more time consuming than of the ERP-BCI, because the latter required no learning to regulate the EEG. With the ERP-BCI 100% accuracy and selection rates of up to 10 items per minute were achieved. If classifiable ERPs can be detected, the ERP-BCI is the method of choice for communication. The SCP- and SMR-BCIs are advantageous if a specific brain response is not readily available, because they allow learning on the basis of operant conditioning. The reason for CI-illiteracy in about 25% of the participants awaits further investigation.

The Neural Signature of Delay Aversion in adult ADHD

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Dysfunctional processing of delay periods has been proposed to be a core deficit in ADHD. Actions related to the achievement of delayed rewards are often combined with signs of behavioral disinhibition, and accompanied with unpleasant feelings (delay aversion). The neural correlates of delay aversion are still unknown.

Using fMRI, 14 adult patients with ADHD and 12 matched controls were investigated during a series of choices between monetary reward options which varied by delay-to-delivery (immediate, 2 or 4 weeks).

Differences between ADHD and controls concerning neural responses toward rewards at different delays were explored within the striatal system along its ventral-dorsal extension, including nucleus accumbens and caudate nucleus (head and body).

Results revealed graded activation-maps within the reward system: ventral-striatal regions show hypo-responsiveness toward immediate rewards in ADHD; dorsal regions exhibit hyper-responsiveness toward delayed rewards in ADHD accompanied by higher activation of bilateral amygdalae and left anterior insula.

Prior evidence of ventral-striatal hypo-responsiveness in adult ADHD on immediate rewards could be replicated. By using graded reward delays, hyper-responsiveness of the dorsal-striatal system in ADHD became evident. We conclude over-activation

of dorsal-striatal system to give rise to the aversive experiences of "wanting" accompanied by concurrent activation of parts of the affective/limbic system.

The auditory P300 in adults with persistent attention-deficit/hyperactivity disorder

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While several electrophysiological studies used CPT go/nogo paradigms, here we aimed to assess a traditional two tone oddball paradigm in adult patients with persistent ADHD under stable medication.

Twenty-five adults with persistent ADHD (36.7y, 10f, 15m) and 21 control subjects (37.4y, 7f, 14m) matched for age, gender and education were presented auditory non-target stimuli (1000Hz, 80ms, 85%) and target stimuli (500Hz, 80ms, 15%, button press). EEG was recorded from midline electrodes. Trials were analysed with regard to N100, P200, N200 and P300 amplitudes.

N100, N200 and P300 amplitudes did not differ between groups and we found no group x electrode interactions. We found a P200 electrode x group interaction ($p=.024$). In controls, P200 target amplitudes decreased from frontal to parietal sites whereas the opposite pattern emerged in patients with ADHD. This effect was confined to target trials.

Our study revealed unimpaired electro-cortical indicators of auditory target processing in medicated patients with persistent ADHD with regard to N100, N200 and P300 components. Patients showed a specific frontal to parietal P200 amplitude shift. The functional significance of this result has to be further investigated.

Struggle between the hemispheres at the "Anarchic-Hand-Syndrome"

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Following an infarct lesion to the genu of the corpus callosum, G.H complains about symptoms of an "Anarchic-Hand-Syndrome": The left hand does what it wants and interferes with actions of the right hand. To obtain better understanding of the underlying mechanisms, we examined reactions and EEG-potentials of G.H. and 12 control participants using a task (the "Simon- paradigm") in which two different stimuli required response selection between the right and left hand and additionally appeared by chance either in the left or in the right hemi-field, making information exchange between the hemispheres necessary.

In general G.H.'s responses were slower with the left than with the right hand. Moreover, electrophysiological measures showed three unusual phenomena: faster activation of the right than the left visual cortex, overactivation of the right parietal

cortex in response to all stimuli, occipital bipolarity at 500-700 ms (negative at O1, positive at O2).

Faster activation of the right visual cortex and overactivity of the right parietal cortex might cause the syndrome. Furthermore the posterior bipolarity might reflect compensatory ways of information transfer over the intact posterior corpus callosum.

The short-term effect of antipsychotic medication on sensorimotor gating in schizophrenia

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The prepulse inhibition (PPI) of the startle reflex is a measure of sensorimotor gating, which is consistently observed when a sensory stimulus shortly precedes the startle eliciting stimulus. Patients with schizophrenia exhibit an impaired PPI. However, the size and stability of these impairments are still discussed. The present study was aimed at elucidating the short-term effect of antipsychotic medication on PPI and further attentional functioning in patients with schizophrenia. The patients were included during the first two days of their inpatient treatment. The assessment of attentional functioning comprised an acoustic PPI paradigm and several tests of selective attention as well. These assessments were repeated every two weeks during the inpatient treatment. Data analyses thus far included 24 patients and 26 controls, who completed three consecutive assessments. Results revealed that patients exhibited PPI deficits during the initial assessment, which rapidly improved across the inpatient treatment resulting in comparable amounts of PPI in patients and controls during the second assessment. By contrast, little improvement was observed for the patients' deficits in selective attentional functioning. Correlational analyses revealed that PPI improvements were unrelated to the selective attentional functioning or to the severity of the psychopathological symptoms.

Psychosocial adjustment to neurodegenerative disease: depression and salivary level of cortisol

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Based on the stress and coping theory of Lazarus and Folkman (1984), this study aimed at investigating the process of psychosocial adjustment of patients with amyotrophic lateral sclerosis (ALS). Variables such as illness parameters, coping strategies, coping resources and cognitive appraisal were considered to determine the psychosocial adjustment, which we operationalized as depression and quality of life (QoL). We assessed psychological variables in 27 ALS patients using standardized questionnaires. Concurrently, we measured salivary cortisol at awakening (T1), 30 minutes later (T2), and before going to bed (T3) on 3 consecutive days. Depression and QoL were not related to the degree of physical impairment and

only 18% of the patients showed clinically relevant depressive symptoms. Elevated cortisol response after awakening was related to a higher degree of depressive symptoms and lower experienced independence, but no association was found to QoL. For the correlational analysis we used a single value for cortisol level by calculating the area under the curve with respect to increase. Results showed that salivary cortisol level may serve as a psychophysiological marker of psychosocial adjustment in ALS. We also replicated earlier results showing that ALS patients experience a satisfactory QoL and are mostly not depressed.

Deficits in the processing of emotional faces in anorexia

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The aims of the present study were to identify differences in emotional processing of faces in anorexic subjects compared to healthy controls by means of visual-evoked potentials and subjective rating information. Different emotional (happy, sad, angry, fearful, and disgust) and neutral faces were presented to 17 healthy, right-handed anorexic females and 17 matched controls while 64-channel EEG data were recorded. Participants were asked to categorize the emotional quality of the facial stimuli. Event-related potentials (ERPs) were computed for each emotion and neutral condition. Significant differences in the ERPs occurred between both groups later than 200 ms after stimulus onset indicating difficulties in the processing of emotional facial information in anorexic subjects. Confirming these results anorexics also made more mistakes in the categorization of facial information especially when judging neutral, sad and angry faces. Our data provide evidence for deficits in the processing of emotional information in anorexia.

Relationship between approach tendencies of reward sensitivity, P300 and gambling behavior

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Several studies suggest that people highly sensitive to reward show great approach tendencies towards rewards and a strong readiness to assume a risk for obtaining these rewards. The aim of the present study was to investigate the relationship between interindividual differences in approach tendencies toward rewards, gambling behavior and event-related potentials as response to positive or negative feedback. Approach tendencies of reward sensitivity of 48 students were measured by using the BIS/BAS-Scales. A 32 channel EEG was recorded while participants were doing a roulette-like gambling task. They were asked to play for high or low stakes and to bet which of two colors will win. After they chose a color, they got feedback if they were correct and win money or if they were wrong and lose their stakes.

We found a significant positive correlation between the mean amplitude of P300 after positive feedback and BAS as well as the amount of stakes the subjects play for. This association between mean amplitude and height of stake is particularly evident during a run of luck and in games with obvious risk differences.

The results are discussed within the framework of interindividual processing of reward and approach tendencies toward rewards.

Feedback processing in male adolescents during performing the Iowa Gambling Task: An ERP Study

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Behavioral problems in adolescents often are accompanied by dysfunctions in feedback processing, which in turn can be the cause of disadvantageous decision-making, finally leading to the point of delinquency.

The Iowa Gambling Task (IGT; Bechara et al., 2000) is a card game designed to simulate real-life decision-making in a way it factors reward and punishment contingencies.

16 adolescent males performed the IGT and, to assess their social behavior, the self-description questionnaire SDQ-D (Goodmann, 1999). ERP components of the subjects' feedback processing in the IGT were analyzed.

Significant correlations between the SDQ-subscale "conduct problems" and the IGT performance-index (net score) were found (-.58, $p < .009$). In addition, the SDQ-Score correlated significantly with the frontal P300 amplitude after negative feedback (.55, $p < .013$).

Applying regression analysis we found that the accuracy of prediction of "conduct problems" can be improved by bearing on both, the ERP and the behavioral score (multiple forecast by the two predictors: .73, $p < .007$). A lack in IGT performance as well as enhanced P300 after loss-making were lead back to impairments in feedback processing and were considered as indicative for some facets of impulsive behavior.

Moral decision-making in male adolescents: An EEG study

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Imagination of self-conducted actions is often found to activate the temporo-parietal junction, mainly at right hemisphere. We investigated the function of these activations in moral decisions. Using EEG alpha to reveal cerebral activation, we considered self conducted actions requiring highly interconnected memory resources (Klimesch et al., 1993).

10 personal and 10 impersonal short stories were presented to 17 male adolescents (14 to 17 years) in order to get judgements on moral dilemmas. In contrast to impersonal ones, personal dilemmas required imagination of scenarios

with intensive bodily engagement. In both conditions, the amount of memory resources while accepting or rejecting proposed action alternatives was measured using the power of individual adjusted alpha frequencies. EEG power was estimated using S-transform.

Increased alpha power was found at parietal electrodes 1500 msec before rejecting an inappropriate proposed action revealing less memory activation. A similar effect occurred in judgements on personal dilemmas. This gives the impression that allocation of interconnected memory resources about ones own bodily options of acting is accompanied by small amount of cortical activation.

Increased parietal theta power was observed in judgements resulting in acceptance of proposed harmful alternatives. Theta is often mentioned as sign for intentional recall. Moral decisions against internalised norms may be preceded by conflict and give rise to memory search in the investigated adolescents.

An fMRI study of decision making in Blackjack

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Recently we reported on medial frontal negativities in the ERP in response to monetary losses in a computer based version of the card game "17 and 4". The present study aimed to examine that same paradigm in an fMRI environment in order to provide evidence for the neural sources of medial frontal negativities in decision making.

The fMRI of 17 subjects was recorded while they played "17 and 4". Each subject played 352 games. In each trial the subjects had to decide at a certain amount of starting points (13-18), whether they wanted to take another card (hit) or not (sit). The subjects goal was to get closer to 21 than a computer opponent, and to avoid getting over 21 points. Subsequently, the cards of the opponent were shown to the subjects and they received feedback, whether they won or lost 10 cent. Bold responses to different degrees of risk and to losses versus wins were analysed.

The subjects showed increased activity in the anterior cingulate in trials with too risky and too cautious decisions. However, there was no increased activity in the anterior cingulate in lost trials as compared to wins.

Relationship between residual switch costs and the frontocentral N2

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Residual switch costs are switch costs which remain even after a long preparation interval. These costs have been recently explained in terms of interference between simultaneously active task-response representations during response selection. In the present experiment, we tested this assumption using electrophysiological

recordings in a combined task switching / go-nogo paradigm. Our results replicate the previously observed absence of residual switch costs in trials following a no-go trial. This absence was accompanied by a largely reduced effect of task switching both on the amplitude and the latency of the frontocentral N2. Moreover, significant correlations between N2-effects both in amplitude and latency on the one hand and residual switch costs on the other suggest a close relationship between both parameters. This finding suggests that residual switch costs may be due to a resolution of task interference indexed by the frontocentral N2.

Neural Correlates of Dynamic Perceptual

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Synchronization of oscillatory activity has been proposed as a dynamic mechanism for the grouping of stimulus elements into coherent object representations (Singer, 1999). In the current study, we examined the relative contribution of neural synchrony to prespecified vs. dynamic grouping processes in visual perception. Perceptual grouping was examined with a contour integration paradigm. Subjects were presented with contours among noise elements for 200 ms. Task difficulty was varied in three conditions by modifying the density ratio of signal to noise elements and by changing the degree in which the signal elements were adapted to the ideal contour. EEG signals were analyzed for evoked and induced spectral power in the beta- and gamma- frequency as well as for phase-locking (Lachaux et al., 1999). Analysis of the behavioural data showed that reaction times as well as error rates increased when the grouping process relied on dynamic grouping mechanisms. EEG data indicate that induced gamma-power did not differentiate between grouping conditions. However, dynamic grouping was found to be stronger correlated with phase-synchrony than during prespecified grouping. These data suggest that dynamic grouping may require long-range interactions between and within cortical areas that are related to the dynamic formation of perceptual objects.

Pupillometry as an index of pain intensity

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Background: Pupillometry can be employed to measure sympathetic and parasympathetic activity and may therefore serve as objective indicator of pain. There is evidence from clinical pain to support such a relationship but there is only one study demonstrating that pupil reactions correlate with the intensity of experimentally induced pain. For the present study, we hypothesized that pupil reactions may serve as an objective indicator of pain intensity. Methods: We applied tonic pressure pain of 20 sec duration to the fingers of 12 healthy females. During

pain induction, participants saw pictures of three different levels of luminance. Pupil dilation was continuously recorded using an infrared video eyetracking system (SMI). Results: Immediately after pain onset, pupil dilation is observed and it reaches its maximum about 2 seconds after pain onset. Maximum pupil dilation does not differ for pressure intensity. From 10 seconds after pain onset until pain offset, level of pupil dilation differs between pressure intensities ($p = .032$), independent of picture luminance. Discussion: Pupillometry can serve as an objective indicator of pressure pain intensity. It can be useful to further explore pain modulation by psychological factors.

Associations between the perception of breathlessness, pain and negative emotions

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The perception of breathlessness shows many similarities to the perception of pain but research comparing both sensations is rare. In addition, some theories of emotions emphasize the role of physiologic sensations for the development of emotions. We examined the associations between the perception of breathlessness, pain and negative emotions. In fourteen healthy volunteers breathlessness was induced by resistive load breathing whereas pain was evoked during a cold-pressure-test. A negative emotional state was induced by watching a picture series (IAPS). Unpleasantness and intensity of perceived breathlessness and pain were measured in each condition; emotional valence and arousal were assessed during picture viewing. Respiratory parameters, heart rate (HR) and respective ratings confirmed successful experimental manipulation in all three conditions. Perceived unpleasantness of breathlessness correlated with perceived unpleasantness of pain ($r=.45$) and with negative emotional arousal ($r=.56$). Unpleasantness of pain showed marginal correlations with negative emotional arousal ($r=.39$), valence ($r=-.37$) and HR ($r=-.41$) during picture viewing. Perceived intensity of breathlessness and pain were not correlated and only weakly associated with negative emotional valence. The results suggest particular associations in the unpleasantness-dimension between the perception of breathlessness and pain which might further be associated with perceived negative emotionality.

Pain modulates valence ratings of affective faces: a pilot study

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Background: According to the motivational priming hypothesis of Lang, an organism's emotional state will modify responses to valenced stimuli. Pain is a negative sensory and emotional experience. Thus, pain experience is expected to inhibit processing of positive and to facilitate processing of negative affective stimuli. Methods: Happy,

neutral, angry and fearful faces were presented to 30 healthy participants, which had to rate valence and arousal of the pictures. Thereby, half of the participants received painful pressure stimulation during presentation of the pictures. Results: For both groups, valence ratings were highest for happy faces and lowest for angry and fearful faces, ratings for neutral faces fell between. However, participants who received additional pain stimulation rated happy faces less positive than participants without pain stimulation. Furthermore, participants with pain stimulation rated fearful faces less negative than participants without pain stimulation. Discussion: Our findings seem to contradict the assumption that pain modulates affective face processing according to the motivational priming hypothesis. In fact, as an attention demanding stimulus, pain seems to distract attention capacity from the emotional stimuli resulting in a more superficial emotional processing as reflected in valence ratings.

Spatial discrimination learning to electrocutaneous stimuli

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Although aspects of spatial discrimination of electrocutaneous stimuli have already been studied, more knowledge is required about the ability to improve spatial discrimination through training. Our study aimed to investigate whether spatial discrimination can be improved through training and whether the type of stimulation - sets of 1, 2, 3, or 4 simultaneously stimulated electrodes (so called constellations) - will have impact on discrimination performance.

Healthy subjects were trained over 5 days to discriminate 23 different stimulus constellations. Stimulation was applied by eight electrodes on the left upper arm. Daily sessions consisted of pretest, training phase, and posttest. In a first experiment, performance of a treatment group was compared to performance of a control group receiving a sham treatment. Results revealed a significantly higher discrimination performance over the whole training period in the treatment group. In a second experiment, performance of one group was compared to performance of another treatment group receiving a modified set of stimulus constellations. No significant differences in discrimination performance we found between these groups.

Our study demonstrates that discrimination of electrocutaneous stimuli can be improved through training. Practical implication, e.g. for biofeedback settings, are discussed.

Hypoglycemia during sleep impairs consolidation of declarative memory in type 1 diabetic and healthy humans

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Sleep enhances the consolidation of declarative memories. Patients with type 1 diabetes mellitus (T1DM) frequently experience hypoglycemic episodes during sleep. We investigated whether short-lasting hypoglycemia during early nocturnal sleep affects the sleep-associated consolidation of declarative memories. Sixteen healthy subjects and 16 patients with T1DM were tested. On one condition, a linear fall of plasma glucose to 2.2 mmol/l was induced during early sleep. On the control condition, euglycemia (> 3.86 mmol/l) was maintained. In the morning, subjects recalled word-pairs learned in the preceding evening. Also, mood and attention were assessed. Following euglycemia, subjects recalled 1.5 ± 0.5 more word-pairs than following hypoglycemia ($P < 0.01$), remembering 2.0 ± 0.6 more word-pairs than at immediate recall before sleep ($P = 0.002$). Across the hypoglycemic night, no such gain occurred ($+0.5 \pm 0.6$ words; $P = 0.41$). Hypoglycemia during sleep also impaired mood ($P < 0.05$), but did not affect attention. Effects were well comparable between T1DM patients and healthy controls. Our findings indicate specific sensitivity of declarative memory consolidation during sleep to rather short episodes of mild hypoglycemia. This effect may disable memory processing in T1DM patients prone to nocturnal hypoglycemic episodes.

ERP effects of high load and high item similarity on short-term recognition

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During short-term memory recognition, higher memory load is thought to increase the number of comparisons to be made, whereas higher target-probe similarity requires participants to match items more precisely. We included both factors in an event-related potential (ERP) study to test whether these two manipulations tap similar or different resources. In a delayed match-to-sample task, either 1 or 3 colours had to be encoded and maintained, and a single probe was presented which either matched, was similar to or was dissimilar to the learned colour(s).

Both similarity and load influenced match-to-sample accuracy and increased response times. The ERP analysis showed a pronounced load effect widely distributed over the scalp which started already at about 150 ms post-stimulus onset and lasted for 900 ms. An effect of item-probe similarity was present between 350-800 ms over centro-parietal and lateral frontal electrodes sites. However, it changed its sign over time: while matches showed a stronger ERP response than both similar and dissimilar lures in the 350-450 time window, this effect was inverted between 450-800 ms.

These results suggest that two distinct neuronal processes were differentially affected by load and item similarity during short-term recognition.

Food Deprivation and Memory Processes: An ERP analysis of the Old/New-Effect

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Food deprivation is thought to selectively increase attention and memory to food cues. The present study examined whether hunger selectively enhances memory processes utilizing the old/new recognition paradigm. In a counterbalanced within subject design, participants (N=32) viewed a series of food and flower pictures in hungry and satiated state. Afterwards, they were asked to identify a subset of these stimuli (20 old and 20 new foods and flowers, respectively) as previously seen or not. Behavioral results showed a category difference revealing that food pictures were better recognized than flower pictures. This effect was not modulated by the 24 hours of food deprivation. Dense sensor ERPs (event-related potentials) revealed the expected old/new-effect for food pictures, i.e., enlarged positive potentials over parietal regions. This difference was equally pronounced in both satiated and hungry state. Similar to studies using food words, a general memory bias for food cues compared to neutral stimuli was revealed while food deprivation had no effect on selective memory to food cues.

Modulation of spatial and stimulus-response learning strategies by exogenous Cortisol

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Previous findings indicated that psychosocial stress modulates the use of hippocampus-dependent spatial and caudate-dependent stimulus-response learning strategies in favour of stimulus-response learning. We hypothesized that an increase in the stress hormone Cortisol is the mediating mechanism. Here, we administered a high (30mg) or low dose (5mg) of Hydrocortison or a placebo to 84 young healthy females prior to training in a spatial task. Participants were presented a 3D model of a room and had to locate a “win”-card out of four. This “win”-card could be identified via spatial and stimulus-response strategies. A test trial revealed the employed learning strategy. Groups were similar with respect to their learning speed during training. However, they differed significantly regarding the applied learning strategy in the test trial ($p < 0.05$). While 29 percent of the 30mg Hydrocortison and 21 percent of the 5mg Hydrocortison group used a spatial strategy, only 4 percent of the placebo group employed this strategy. Thus, the effect of exogenous Cortisol was opposite to the reported influence of psychosocial stress on the modulation of spatial and stimulus-response learning strategies. Our findings indicate that Cortisol modulates the use of spatial and stimulus-response strategies in a manner that is not fully understood yet.

Implicit sequence learning reduces task-induced autonomic arousal

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The aim of the present study was to investigate whether implicit learning of certain sequence regularities of a quasi-randomised choice reaction time task induces less task-induced autonomic arousal than performing a truly randomised version of the same choice reaction time task.

After 10 minutes at rest and a baseline blood pressure measurement for 5 minutes, 20 subjects performed a 5-choice reaction time task by responding to coloured lights by pressing coloured buttons. While 10 of these subjects responded without knowing to a sequence with certain regularities in the stimulus sequence (learning group), the other 10 subjects responded to a randomised stimulus sequence (random group). Beat-to-beat cardiovascular parameters (inter-beat interval length, blood pressure data) were recorded continuously, while the subjects finished 10 blocks (100 trials per block, ISI = 1000ms) of the serial reaction time task.

Initially, both groups did not differ in inter-beat interval length. However, after 5 blocks when the implicit learning group showed effective performance increases the learning group differed statistically significant from the random group in a longer inter-beat-interval. All subjects remained unaware of the learning sequence.

Our data indicate a lower activation of the autonomous nervous system that emerges from the advantage of implicit learning.

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ISBN 978-3-9808342-4-7