differences per se and in interaction with theta burst stimulation (TBS) over the right posterior parietal cortex (PPC).

Method: Visuospatial attention in healthy female and male subjects was measured using eye movements during free visual exploration of real-life scene images. Subjects performed the task twice (once without stimulation and once after TBS over the right PPC) in a repeated-measures, counter-balanced design. Several oculomotor variables derived from fixation analysis were evaluated, including centre of exploration, spatial distribution of fixations as well as their duration on different subdivisions of the screen.

Results: Gender per se yielded no significant effects on the free visual exploration behaviour, i.e. male and female subjects did not have significantly different visual exploration patterns in the control condition. However, there was a significant interaction with TBS: In male subjects, a significant and consistent neglect-like visual exploration pattern was observed, characterized by a rightward shift. Conversely, in female subjects no significant shift of the exploration pattern was detected.

Conclusion: Three hypotheses are proposed to account for gender-specific TBS effects. The first hypothesis involves possible anatomical sexual dimorphisms influencing TMS effects. The second hypothesis is based on potential differences in functional hemispherical lateralization for visuo-spatial processing in males and females, probably also modulated by hormonal influences. Finally, the third hypothesis refers to supposed interhemispheric effects of TMS and explains gender-specific effects as a result of a differential hemispherical connectivity.

TMS
Poster Only

85 Relationships between handedness and interhemispheric transfer time

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Objective: Handedness is reflected in the brain as larger structural size and functional area of the primary motor cortex (M1) contralateral to the dominant hand. Moreover, less strongly handed individuals exhibit more ipsilateral M1 recruitment (Dassonville et al., 1993). Previous research has shown that extreme left handers (LH) have more efficient interhemispheric interactions than extreme right handers (RH), with mixed handers in between (Cherbuin & Brinkman, 2006). In the current study, we seek to further understand the relationships between handedness and interhemispheric interaction, in addition to looking at these factors in relation to maps of the motor cortex.

Method: LH and RH subjects (n = 21, 20 + 1.4 yrs, 9 male, 4 LH) performed the Poffenberger Paradigm (PP; Poffenberger, 1912). Participants fixated on a cross, and a dot was presented in either the left or right visual field (6.02° eccentricity) for 50 msec; participants responded with a button press as soon as they saw the dot. 400 responses were made with each hand totaling 800 trials. In addition, participants completed the Edinburgh Handedness Inventory (EHI; Oldfield, 1971) as well as the Purdue Pegboard test, grip strength testing, and a circle and square tapping task (Janke, 1996) to quantify handedness. Interhemispheric transfer time (IHTT) was quantified using the crossed-uncrossed difference (CUD) based on the crossed (visual information presented ipsilateral to responding hand) and uncrossed (visual information presented contralateral to responding hand) reaction times in the PP. Participants also completed transcranial magnetic stimulation (TMS) mapping of the M1 hand area (Sparinger et al., 2008). Data collection is ongoing.

Results: We observed a significant difference in CUD between LH and RH subjects ($p<.01$), with LH subjects having faster CUDs. CUD is also correlated positively with both scores on the EHI ($p<.01$) and laterality index calculated from square tapping scores ($p<.05$). However, when we use the absolute value of EHI and CUD scores to examine degree of handedness, there is no significant correlation ($p = .35$).

Conclusions: Direction of handedness influences IHTT, but there is not a relationship with degree of handedness. TMS data will be used to determine whether behavioral measures of handedness and interhemispheric efficiency are related to cortical representations in M1 of both the dominant and non-dominant hemispheres.

TMS
Poster Only

86 Plasticity in primary somatosensory cortex in young and older humans

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Objective: Cortical plasticity effects on motor or somatosensory cortex are induced by the Paired Associative Stimulation (PAS) protocol, and long-term potentiation (LTP) - depression (LTD) mechanisms were proposed on the basis of independent evidences. PAS consists of pairing a repetitive peripheral electrical stimulation with cortical Transcranial Magnetic Stimulation (TMS). The effects of this protocol on motor or somatosensory cortex are valuable by changes in amplitude of motor evoked potentials (Stefan et al., 2000) or somatosensory evoked potentials (Wolters et al., 2005; Litvak et al., 2007), respectively. Since age-dependent effects have been shown for motor cortical plasticity (Tecchio et al., 2008; Florian et al., 2008), the aim of the present study is to investigate the same effects in somatosensory cortex.

Method: Thirty-two healthy subjects participated at the study: 16 elderly (mean age = 62.1, SD = 1.5 years) and 16 young (mean age = 26.2, SD = 0.8 years). A single electrical stimulation delivered to the right median nerve (MN) at the wrist (stimulation intensity of 300% of the perceptual threshold) was followed by TMS (stimulation intensity of 130% rMT) on S1. The interval between MN stimulation and the subsequent TMS pulse was set at N20 latency. Median nerve-evoked somatosensory-evoked potentials (MN-SSEPs) were recorded before and after PAS intervention.

Result: PAS affected SSEPs in the time-window between 20-25 ms in both age groups, inducing an mean increase of N20-P25 complex by 5.4% in young and 9.4% in elderly subjects. A significant Age group x Treatment interaction points to that this increase of N20-P25 amplitude after PAS is larger in elderly ($p = 0.000004$ at the post-hoc t-test) than in young subjects ($p = 0.03$ at the post-hoc t-test). Ageing and PAS affect the amplitude of P25 component and are not associated to significant changes of N20 amplitude. Finally, the PAS does not affect the amplitude of P14, N30, and P40 components.

Conclusion: Present results indicate an increase in S1 plasticity both in young and elderly subjects, due to LTP-like mechanisms. The wider effect of PAS on P25 component in elderly subjects could be explained by an age-related increase in cortical excitability on an overall enhanced level of activity in the somatosensory cortical system (Huttunen et al., 1999).

rTMS
Poster Only

87 Assessment of long-term, within-session effects of high-frequency repetitive transcranial magnetic stimulation on a cognitive task

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Typically, studies on cognition involving repetitive transcranial magnetic stimulation (rTMS) evaluate the effect of stimulation by comparing task performance during trials with rTMS to that of trials without rTMS or sham stimulation. Moreover, stimulation is often blocked by brain region, in which multiple trials are performed under rTMS of the same site. It is, however, possible for the effects of rTMS to last beyond the duration of the train of stimulation, and perhaps even beyond the stimulation block, thereby influencing subsequent task performance and affecting results. There have been no studies in the cognitive domain examining such possible long-term, within experimental session effects, and it therefore remains unclear whether stimulation of separate brain regions should also be separated by a significant amount of time.

We evaluated potential long-term, cumulative effects of rTMS on a spatial working memory task. In 54 subjects, 10 Hz rTMS trains (110% resting motor threshold) were applied for 3 sec to five different brain regions, across 2 separate experiments. In each experiment, 3 brain regions were targeted, all within the same session. As a result, each subject received approximately 2200 pulses over the course of 2 hours. Stimulation of each brain area was divided into 4 task blocks. rTMS-absent trials were randomly interleaved between rTMS-present trials and these were compared in order to assess effects of rTMS on task performance. Long-term effects of rTMS were assessed by investigating changes in performance across the 4 task blocks. Results showed that for these rTMS parameters, the effects of rTMS accumulated to have a small effect on working memory task performance. This effect was most evident only when the prefrontal or right parietal cortices were targeted. Researchers investigating cognition should take these results into consideration when using similar approaches.

TMS

Poster Only

88 Magnetic stimulation in evaluation of phrenic nerve function in acute exacerbation of chronic obstructive pulmonary disease

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Objective: In patients with chronic obstructive pulmonary disease (COPD) with history of recurrent acute exacerbations (AE), the diaphragm may contribute to respiratory decompensation. Magnetic stimulation is a simple and non-invasive test that can be used for evaluate diaphragmatic function in AE-COPD.
Method: Included in this study were 41 patients with AE-COPD their mean age was 57.9 ± 11.7 years. We correlated phrenic nerve central and peripheral electrophysiological results [motor evoked potential (MEP) latencies, amplitude, duration, central conduction time (CCT) and predicted excitability] with various parameters of pulmonary function testing (FVC, FEV1 and FEV1/FVC), arterial blood gases (pH, paO2, pCO2 and HCO3) and electrolytes (Na+, K+ and Cl-).
Results: Compared to controls, patients demonstrated significant prolongation in central and peripheral MEP latencies, CCT, amplitude reduction and increased excitability threshold of phrenic nerves. Significant negative correlation was identified between central and peripheral phrenic nerves amplitudes, severity of COPD, hypoxemia, acidosis, serum HCO3 and Cl-levels while positive correlation was identified with phrenic nerves latencies, excitability threshold and paCO2.
Conclusion: As far as our knowledge, this is the first study in our country utilizing magnetic stimulation as a prognostic measure to evaluate the function of the phrenic nerve in patients with AE-COPD. Magnetic stimulation is a non-invasive, well tolerated and easily applicable procedure that can be simply utilized for assessment of phrenic nerve function. Early detection of phrenic nerve dysfunction in patients with AE-COPD is in accordance with the importance of early oxygen therapy in reducing morbidity and mortality from this chronic illness.
Keywords: Acute exacerbation of chronic obstructive pulmonary disease; diaphragm; phrenic nerve stimulation; Magnetic Stimulation.

rTMS

Poster Only

89 iTBS of primary motor cortex improves spasticity in MS patients

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Objective: Spasticity in multiple sclerosis (MS) is one of the most severe and disabling symptoms which restricts patients quality of life.
In a previous study we showed that facilitatory 5 Hz repetitive Transcranial Magnetic Stimulation (rTMS) applied over the leg primary motor cortex (M1) was able to improve lower limb spasticity in MS. Such clinical improvement was associated with reduction of H/M amplitude ratio measurements.
Methods: Here we applied two other protocols known to increase the excitability of M1: the intermittent theta burst stimulation (iTBS; 600 pulses, 190 sec) and the anodal transcranial direct current stimulation (tDCS; 2 mA, 10 min). We studied 10 remitting patients with relapsing-remitting multiple sclerosis and lower limb spasticity (1.5 < EDSS < 3.5). Five patients were treated with tDCS, five were treated with iTBS. We evaluated changes on excitability of the leg primary motor cortex following two weeks of stimulation. We assessed changes on stretch reflex by using H/M amplitude ratio measurements over soleus muscle. Spasticity was clinically evaluated using the Ashworth scale and by study participants using the MSSS88.
Results: A single session of iTBS decreased H/M amplitude ratio but didn't clinically improve spasticity. A significant clinical and electrophysiological improvement of lower limb spasticity was observed after a 2-week period of iTBS treatment. Clinical improvement was long-lasting (14 days after the end of treatment). Decrease of H/M amplitude ratio persisted at least 21 days after the stimulation. tDCS didn't significantly interfere with H/M amplitude ratio and did not induce any effect on spasticity.
Conclusion: Intermittent theta burst stimulation could be a useful tool to improve spasticity in multiple sclerosis.

tDCS

Poster Only

90 Voluntary muscle contraction reveals homeostatic plasticity in human motor cortex - Evidence from transcranial direct current stimulation (tDCS)

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Objective: Homeostatic plasticity (HP) regulates the synaptic strength of neurons within the physiological range, depending on the amount of prior synaptic activity. While neurophysiological evidence to the existence of HP in the human cerebral cortex exists, the behavioural relevance of HP remains to be established. Our study was aimed at showing that voluntary muscle contraction (VMC) could interfere with the after-effects of transcranial direct current stimulation (tDCS) and thereby reveal homeostasis in the human motor cortex at the behavioural level too.
Method: Sixteen healthy human volunteers (12 m, 4 f; all right-handed) participated in the study. We conducted five sessions for each subject in randomized order – anodal/cathodal/sham tDCS with/without VMC. The motor hot spot was stimulated with anodal/cathodal/sham tDCS: for 20 min with anodal or cathodal tDCS of 1 mA current strength and for 30 sec in the sham condition. Subjects were asked to contract the right First Dorsal Interosseous to 20% of maximum possible contraction for 120 seconds after tDCS. For the sessions which did not involve VMC, there was a corresponding 2 min break before we proceeded further. During each session, we measured the motor threshold (MT), MEP amplitude (Single-pulse TMS paradigm), short-latency intra-cortical inhibition (SICI) and facilitation (ICF) (Paired-pulse TMS paradigm) and cortical silent period (CSP). Each parameter was measured both before and after tDCS with/without VMC.
Results: Our results revealed a change of aMT following tDCS: anodal stimulation caused a small, but significant decrease in aMT while cathodal stimulation increased it. Coupling tDCS with VMC, there was reversal of this effect. For single pulse MEP amplitudes, VMC resulted in a reduction of anodal tDCS induced M1 excitability enhancement, while VMC preceded by cathodal tDCS reversed the tDCS-induced reduction of M1 excitability. The reduction of SICI accomplished by anodal tDCS was