(range 130 to 190 ms). In all subjects, the left and right fusiform response was earlier in time and stronger in dipole moment in response to face compared to food stimuli with main effects for latency (faces 155.5 ms (SE 5.8 ms); foods 177.3 ms (SE 4.1 ms); both p < 0.01) and amplitude (faces 46.1 nAm (SE 5.4 nAm); foods 26.0 nAm (SE 4.7 nAm); both p < 0.01). No significant condition X hemisphere interaction was found. Present findings are in-line with previous studies indicating areas within the fusiform gyrus most sensitive to face-specific stimuli. The findings also demonstrate the robustness of this phenomenon since a delayed and weaker fusiform response to non-socially relevant stimuli was observed in 100% of the subjects. The magnitude of the latency advantage for faces versus food (approximately 20 ms in healthy subjects), along with the robustness of the observation, offers potential utility as a biomarker for social impairment (where, by hypothesis, it is reduced) and thereby as an index for quantitative monitoring of socialization therapy.

### Poster: 2-6 Clinical MEG: Pain and somatosensory function

#### 2-6-1: Aberrant somatosensory evoked responses imply GABAergic dysfunction in Angelman syndrome

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A role for GABAergic inhibition in cortical sensory processing is one of the principle concerns of brain research. Angelman syndrome (AS) is thought to be one of the few neurodevelopmental disorders with GABAergic-related genetic involvement. AS results from a functional deficit of the imprinted UBE3A gene in 15q11-q13, resulting mainly from a 4-Mb deletion that includes GABAA receptor subunit genes. These genes are believed to affect the GABAergic system and modulate the clinical severity of AS. To understand the underlying cortical dysfunction, we have investigated the primary somatosensory-evoked responses in AS patients. Subjects included eleven AS patients with a 15q11-q13 deletion (AS Del), two AS patients without a 15q11-q13 deletion, but with a UBE3A mutation (AS non-Del), six epilepsy patients (non-AS) and eleven normal control subjects. Somatosensory evoked fields (SEFs) in response to median nerve stimulation were measured by magnetoecephalography. The N1m peak latency in AS Del patients was significantly longer (34.6 ±4.8 ms) than that in non-AS patients (19.5 ±1.2 ms, P < 0.001) or normal control subjects (18.4 ±1.8 ms, P < 0.001). The next component, P1m, was prolonged and ambiguous, and was only detected in patients taking clonazepam. In contrast, waveforms of AS non-Del were similar to that of control, rather than to AS Del. Thus, GABAergic dysfunction in AS Del patients is likely due to hemizygosity of GABAA receptor subunit genes, suggesting that GABAergic inhibition plays an important role in synchronous activity of human sensory cortex.

#### 2-6-2: Somatosensory evoked magnetic fields in patients with tongue sensory deficits

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Quantitative evaluation of the tongue sensory disturbances is important clinically. Somatosensory evoked fields following tongue stimulation was applied to overcome the difficulty of using electrophysiological approach to the peripheral nerve in the oral area. Six patients with unilateral tongue deficits were recruited (6 right side). Abnormal sensation area and its symmetric normal sensation area were stimulated electrically using pin electrodes non-invasively. The same stimulus intensity was used for both sites, which was adjusted to 4 times sensory thresholds in the normal area. 600 times were averaged. The signals recorded by 204-channel planar gradiometers out of whole-head 306 sensors were used for analysis. The band pass was 0.1 to 990 Hz and the sampling rate was 2997 Hz. The mean amplitude between 10 and 150 ms for the root mean square (RMS) was calculated from the 18-channel over the contralateral hemisphere (RMS[10, 150]). To estimate the activated cortical response, we calculated the difference of RMS[10, 150] and RMS[50, -5] and termed it as aRMS. (aRMS = RMS[10, 150] - RMS[50, -5]). Although normal area stimulation elicited 2 to 4 responses in all subjects, abnormal area stimulation showed smaller response in 4 patients. The across-subject average of the aRMS for the normal and abnormal side stimulation were 7.02 ± 1.92 and 1.72 ± 1.59 fT/cm, respectively. Significant difference of the aRMS was recognized between the sides of stimulation. The cortical activation evoked by abnormal side was significantly smaller than that after normal area in all patients.
**2-6-3: Magnetoencephalography in investigating somatosensory processing in very low birth weight infants**

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One of the major achievements in contemporary neonatal medicine is the increased survival of very low birth weight (VLBW) infants. Many of these infants develop with neurological impairments, however, and new prognostic methods are needed. We recorded somatosensory evoked magnetic fields (SEFs) from 16 VLBW infants and 16 healthy term newborns during natural sleep to determine possible changes in somatosensory processing in the VLBW infants. The infants form a part of a larger multimethodological study still in progress. The general morphology and latency of the SEFs were similar between the groups. In the patients, the equivalent current dipole (ECD) strength of the first prominent cortical response, M60, was significantly weaker (p<0.05). In four VLBW infants, who had lesions of the underlying hemisphere depicted by ultrasound or magnetic resonance imaging, a later M200 response was absent or could not be modeled. The differences in the SEFs between the patients and controls indicate that preterm birth and associated conditions may alter the functioning of the somatosensory cortex. The lower ECD strength may reflect weaker synchrony in firing or a smaller number of simultaneously activated cortical neurons. At the individual level, the lack of the later response, M200, seemed to coexist with abnormal anatomical findings in a number of VLBW infants. Our upcoming 2 years follow-up may shed light to the prognostic utility of the SEFs.

**2-6-4: Somatosensory evoked magnetic fields in adolescents with congenital spastic hemiplegic cerebral palsy**

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Cerebral palsy (CP), caused by a non-progressive lesion in the developing brain, comprises a heterogeneous group of disorders of movement. In addition to the motor symptoms, the condition may involve various sensory deficits, which in turn hinder the development of the motor skills. We recorded somatosensory evoked magnetic fields (SEFs) to electrical stimulation of the median nerves and tactile stimulation of the index and little fingers in 14 CP adolescents with congenital spastic hemiplegia (age range 11-16 years). These subjects belong to an ongoing study investigating the effects of peripheric sensory electrostimulation therapy on the motor and tactile capabilities of the affected upper limbs. The aim of this preliminary study was to characterize their SEFs from the primary somatosensory (SI) cortices at the onset of the rehabilitation trial. Median nerve and tactile stimulation of the healthy side elicited SEFs from the contralateral SI. On the affected hemisphere, the SI response to contralateral median nerve stimulation was missing or markedly abnormal in four patients. Accordingly, the early SI response (M50) to tactile stimulation of the index and little finger was missing in these four subjects. In the other ten, the early components of the SI responses to both kinds of stimulation could be detected also from the affected hemisphere. These preliminary results form basis for further neuromagnetic studies on CP and neural mechanisms of its rehabilitation.

**2-6-5: Optimization of Sacral Surface Therapeutic Stimulation by Somatosensory Evoked Fields**

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Purpose: Sacral surface therapeutic electrical stimulation (SSTES) is effective for the treatment of refractory urinary incontinence and frequent micturition. SSTES parameters were investigated by measuring the brain response using magnetoencephalography (MEG) in six healthy males.

Materials and Methods: Electrical stimuli were applied to small (20 × 45 mm) or large (40 × 90 mm) surface electrodes placed over the bilateral second to fourth posterior sacral foramen with weak (3 times the sensory threshold) or strong (just below the pain threshold) intensity for each electrode size. Somatosensory evoked fields (SEFs) for the stimuli were measured with a helmet-shaped MEG system. At the first peak around 30 ms (M30) originated from primary somatosensory cortex, and source strength was estimated by an equivalent current dipole model.

Results: Both the sensory and pain thresholds for the large electrodes (6.2±1.9 and 43.2±14.6 mA) were significantly (p<0.05) higher than those of the small electrodes (3.0±0.9 and 24.0±10.3 mA). The maximum stimulus intensity (pain threshold for the large electrodes) evoked significantly shorter latency.
(30.2 ± 1.0 ms) response than weaker intensities. Significantly larger dipole strength was obtained with higher stimulus intensity under all stimulus conditions. Conclusions: Larger electrodes enable toleration of stronger stimulus due to higher pain threshold. The shorter peak latency and larger dipole moments of the primary somatosensory response suggest more effective stimulus at the sacral level. MEG provides an objective and non-invasive method to optimize the stimulation parameters of SSTES.

2-6-6: Modified standardized low-resolution brain electromagnetic tomography for quantitative analysis of MEG

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Objective: Equivalent current dipole (ECD) models require prior knowledge of the number of current sources and optional selection of sensors for the solution of inverse problems. In contrast, a spatial filtering technique, standardised low-resolution brain electromagnetic tomography (sLORETA) can analyze magnetoencephalography (MEG) data without sensor selection. To utilize sLORETA as a quantifiable method, we have modified sLORETA (sLORETA-qm). The purpose of this study is to determine whether sLORETA-qm can be used for quantitative analysis in MEG.

Methods: Initially, somatosensory evoked fields (SEFs) were obtained from 10 hemispheres of five healthy volunteers stimulated on the median nerve at 0.75, 1.0, 1.25, 1.5, 1.75 and 2.0 × the threshold of thenar muscle twitch (TMT). The intensity changes of N20m were analyzed quantitatively using sLORETA-qm. Second, SEFs were measured with stimulation on the median nerve at 1.5TMT from 47 hemispheres in 24 subjects. sLORETA-qm intensity and the ECD moment of N20m were calculated, and relationships between the two values were evaluated. Results: sLORETA-qm intensity increased linearly with stimulus intensity between 0.75 and 1.5TMT, and tended to reach a plateau or decrease at higher stimulus intensities. The distribution of the sLORETA-qm intensity after natural logarithmic transformation was normal and a close correlation was found between the ECD moment and the sLORETA-qm intensity (rs = 0.91, p < 0.001). Conclusions: Our study focusing on N20m suggested that sLORETA-qm is reliable for quantitative analysis of MEG as well as ECD models.

Poster: 2-7 Clinical MEG: Mental disorder

2-7-1: Pre-movement left sensorimotor activation is stronger in adolescents with psychosis

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INTRODUCTION: Schizophreniform and affective psychoses are commonly associated with sensorimotor abnormalities, including deficits in motor control (e.g., mirror movements). These aberrations in basic motor behavior are amongst the earliest symptoms, as multiple lifespan studies have showed motor overflow deficits in children who are later diagnosed with psychosis during adulthood. In this study, we used a flexion-extension task to probe motor cortices in early-onset psychosis. METHODS: Fourteen adolescents with early-onset psychosis and 10 matched controls completed two blocks (left/right) of unilateral flexion-extension of the index finger as whole-head MEG data were acquired. These MEG data were imaged in the frequency-domain using beamforming and the resulting event-related synchronizations and desynchronizations (ERS/ERD) were subjected to voxel-wise statistical analyses of group effects. RESULTS: Compared with typically-developing controls, adolescents with early-onset psychosis exhibited greater pre-movement beta ERD activity in the left precentral gyrus during right finger movements and the left postcentral gyrus during left finger movements. There were not significant between-group activation differences for post-movement ERS activity. DISCUSSION: These data indicate abnormal neuronal activity in left sensorimotor cortices preceding and coinciding with the movement onset in early-onset psychoses. These responses suggest that regardless of the limb most featured in the movement, the left sensorimotor regions of adolescents with psychosis are over engaged in motor control. Supported by: NIMH R01-MH63442 (D.C. Rojas) and F32-MH78359 (T.W. Wilson)