than 40 or less than -40 was defined as left or right hemisphere language dominancy, respectively. Otherwise, language dominancy was not determined (ambiguous). The relationship between the side of epileptogenic focus and language-dominant hemisphere was investigated.

**Results:** Language dominancy was identified in the left hemisphere in 75% (9/12) of the cases with right hemisphere epilepsy, in 52% (12/23) of left hemisphere epilepsy, and in 25% (1/4) of epilepsy with unknown focus. Results were not interpretable for technical reasons in 4 patients. Conclusion: The right-side or ambiguous language dominancy is relatively frequent in patients with intractable focal epilepsy, especially in those with epileptogenic focus in the left hemisphere, implying that the presence of epileptogenic lesion could re-distribute language function in the brain. This finding should be taken into consideration in planning epilepsy surgery and estimating risks in post-operative language deficits.

**2-9-3: Determination of Language Dominant Hemisphere by Magnetoencephalography – A Comparison with Wada Test –**

*Yuu Kaneko1,3, Mitsutoshi Okazaki2, Taisuke Otsuki1, Kunimasa Arima3*

1Department of Neurosurgery, National Center of Neurology and Psychiatry, 2Department of Psychiatry, National Center of Neurology and Psychiatry, 3Department of Laboratory Medicine, National Center of Neurology and Psychiatry

We established the method for determining language dominant hemisphere by magnetoencephalography (MEG) and compared the results with Wada test. Twenty-seven patients with intractable epilepsy participated this study. All patients underwent both MEG and Wada test. In MEG examination, the patient was presented with Chinese characters and Hangul letters and he/she was asked to read only Chinese characters silently. The event-related frequency change was investigated and statistical difference between 2 stimuli was mapped onto the brain surface with high time resolution. Wada test was performed by administrating propofol via bilateral internal carotid arteries. In general, MEG analysis contains 3 finding; the response for charter recognition in the posterior temporal lobe at 200 msec, those for pronounce in the Broca area at 400 msec and those for verification in the Wernicke area at 600 msec. Language dominant hemisphere was determined by these 3 findings with most emphasis on the response in the Broca area. Fifteen patients were diagnosed as left dominance by MEG and 13 of them were diagnosed as left dominance and 2 patient was diagnosed as bilateral dominance by Wada test. Nine patients were diagnosed as right dominance by MEG and 5 of them were diagnosed as right dominance, 2 patient was diagnosed as bilateral dominance and 2 patient was diagnosed as left dominance by Wada test. Two patients were diagnosed as bilateral dominance by MEG and 1 of them was diagnosed as left dominance and the 1 patient was diagnosed as right dominance by Wada test. One patient presented no response and could not be diagnosed by MEG. Our method is excellent in presenting the dynamics of language processing and MEG diagnosis was verified as correct in most cases.

**2-9-4: Auditory evoked fields in children with language impairment**

*Elina Pihko1, Teija Kujala2, Annika Mickos3, Roger Byring3, Marit Korkman4*

1BioMag Laboratory, Hospital District of Helsinki and Uusimaa, HUSLAB, Helsinki, Finland, 2Cognitive Brain Research Unit, Department of Psychology, University of Helsinki, Finland, 3The Research Center of Samfundet Folkhälsan, Helsinki, Finland, 4Department of Psychology, University of Helsinki, Finland

We compared automatic cortical speech-sound processing and discrimination between a group of children with specific language impairment (SLI) and control children with normal language development. Subjects were 22 Finnish 6-year-old (mean age: 6.6 years; range 5-7 years) bilingual (Swedish-Finnish) pre-school children. We measured auditory evoked magnetic fields using whole head MEG (306-channels) to two sets of CV syllables, one with a changing consonant /da/ba/ga/ and another one with a changing vowel /su/so/sy/. The measurements were done in an oddball paradigm in two different blocks. The stimuli were presented with an interstimulus interval of 700 ms. The P1m responses for onsets of the "standard", repetitive stimuli were weaker in the SLI group than in the control children. However, no significant group differences were found in the mismatch responses. The results indicate that the SLI group, having weaker responses to the onsets of sounds, might have slightly depressed sensory processing of auditory phonemic stimuli. While it is assumed that multiple risk- and protective factors are involved with SLI these results add to the discussion of the possible underlying reasons for SLI.

**2-9-5: Causal Prefrontal-Temporoparietal Interactions are Correlated with Word-Rhyming Performance in Reading Disabilities.**

*Richard Frye1, Meng-Hung (Roger) Wu 2, George Zouridakis 2, Jacqueline Liederman3*

1University of Texas Health Science Center, 2University of Houston, 3Boston University

Magnetoencephalography (MEG) studies on children with reading disabilities (RD) demonstrate abnormal early
activation of the prefrontal cortex (PFC), suggesting early bottom-up activation of the PFC area. Such early PFC activation has not been correlated with performance on a phonological word decoding task and has not been shown in adults with RD. We measured directional and mutual connectivity between the left PFC and temporoparietal (TP) areas during a reading task that required explicit orthographic-to-phonological decoding using Dynamic Autoregressive Neuromagnetic Causal Imaging (DANCI). Low-gamma (30-60 Hz) MEG activity from sensors overlying the left PFC and left TP areas was analyzed using a 22ms analysis window during a 300ms pre-stimulus period in RD and normal reading young adults. Prior to the MEG scan, all participants performed a non-word rhyme task similar to the one performed in the MEG scanner. Directional and mutual connectivity between the TP and PFC areas was correlated with the sensitivity measure (d-prime) derived from the non-word rhyme performance data. Stronger bottom-up influence from the left TP area to the left PFC area was strongly correlated with poorer performance (lower d-prime) on the non-word rhyme task for individuals with RD but not TD individuals. Stronger mutual connectivity between the PFC and TP was correlated with better performance (higher d-prime) on the non-word rhyme task for the RD, but not the TD, group. These data help clarify the organization and hierarchical architecture of neural networks responsible for compensation in RD. Tightly coupled interactions between the TP and PFC appear to be necessary for compensatory processes to work effectively. These findings are consistent with simulation data that shows that relative delays in the neuronal signal transmission can substantially influence network synchronization and reduce synaptic plasticity and learning.

2-9-6: A comparison of MEG and fMRI localizations obtained from an expressive language task in a group of adolescents

*Elizabeth W. Pang1,2, Marion Malone1, Frank Wang2, Darren Kadis1,2, Elizabeth J. Donner1,2
1Hospital for Sick Children, 2University of Toronto

While receptive language localization is well understood in the MEG, there is a paucity of data regarding the spatial and temporal characteristics of expressive language function, particularly in the pediatric population. In this study, we had a two-fold objective: to develop MEG expressive language tasks suitable for use in our clinical pediatric population, and, to directly compare MEG findings with results from homologous tasks in fMRI. Ten healthy, right-handed English-speaking adolescents (14-17 yrs) were tested with both MEG and fMRI. Three covert expressive language tasks were included: naming of picture stimuli, verb generation to picture stimuli, and verb generation to written stimuli. MEG data were acquired on our 151-channel whole-head system (CTF Omega) and fMRI data were acquired on our 1.5 T Signa Advantage (GE) machine. As expected, the fMRI data demonstrated significant activation in left inferior frontal gyrus for all three tasks. For each of the three tasks, the MEG data were analyzed with synthetic aperture magnetometry. The group averaged MEG results demonstrated beta band (13-30 Hz) desynchrony at 300-600 ms post-stimulus in left inferior frontal gyrus. Desynchrony in this frequency band has been found to correlate with fMRI localizations on other cognitive tasks. In summary, we met our two-fold objective. First, our three MEG expressive language tasks showed high localization concordance with traditional fMRI tasks. Second, in a group of adolescents, we found that both picture and word based verb generation tasks were able to localize inferior frontal language areas. Our successful use of a picture-based task suggests that this is a promising candidate for application in pre-literate and/or clinical populations.

2-9-7: Event-Related Beamformer Analysis of Language Activation Sequence

*Stephen E. Robinson1, Susan Bowyer1, Norman Tepley1
1Henry Ford Hospital

The scalar linearly constrained minimum-variance (LCMV) beamformer performs very well in the presence of magnetic interference. We tested event-related beamformer imaging of language, using a covert picture-naming protocol. The unaveraged MEG data was processed by beamformer in a 0.1 to 50 Hz passband, yielding coefficients for voxels at intervals of 5 mm, in 3-dimensions. The average and ± average were also computed from the same data. The beamformer coefficients were applied to the averages, yielding their corresponding source waveform estimates for each voxel. After subtraction of the pre-stimulus mean value from these waveforms, the mean-square power was computed for a specified response time window for both the average and ± average. The value assigned to each voxel was computed using the expression: $T = \frac{[S_{avg}^2 - S_{pma}^2]}{N_2}$, where $S_2$ is the source power for the average, and ± average, respectively, and $N_2$ is the beamformer noise power. Negative values of $T$ are not displayed, as this implies that the source activity at that location is not event-related. Functional image showing the activation sequence were computed for 50 ms response time windows, advanced in 25 ms increments from 0 to 700 ms following the trigger. Beamformer analysis was applied to each of two runs of the picture-naming protocol for each subject. The variability of the beamformer functional images was excellent across separate runs within each subject, as this method has reduced susceptibility to noise and interference across runs in an individual. Each run within a subject showed the same
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activation sequence for timing and location. Activation was first seen in visual cortex - propagating to the temporal lobe region then to inferior frontal gyrus. We have show that the beamformer can provide reproducible results for repeated runs within subjects. Research supported by NIH/NINDS Grant No. R01-NS30914.

2-9-8: MEG Applications for Detecting Dyslexia with Real & Nonsense Word Reading

*SM Bowyer1,2, M Greenwald2, JE Moran1, KM Mason1, N Tepley1, R Lajiness-ONEILL1,3

1Henry Ford Hospital, 2Wayne State University, 3Eastern Michigan University

The words "dyseidetic" and "dysphonetic" are used to characterize individuals with difficulties in reading via a lexical "whole word" route versus those with a primary difficulty in reading via a sublexical route of grapheme to phoneme translation, respectively. It is unclear to what extent phonological (sublexical) processing may influence lexical reading. We examined the timing and sources of brain activation underlying clinical symptoms of these subtypes of dyslexia. MEG data were acquired from 14 subjects (7 female; 10-40 years of age), 7 with dyslexia (4 dyseidetic and 1 dysphonetic), and 7 normal readers. Visual presentations of four printed letters representing a real word (i.e. "heat") or a nonsense word (i.e. "ateb") were presented. MEG data were collected while each subject read the real and nonsense words aloud. Data were collected at 508 Hz and bandpass filtered 1-30 Hz. Data were analyzed with MR-FOCUSS and Coherence mapping. Normal readers read both real and nonsense words without difficulties. Subjects with dyslexia read real words fluently but had difficulties decoding and synthesizing nonsense words. Inferior frontal areas were found to be more active in both subjects during nonsense words compared to real words consistent with an anterior system involved in word analysis (decoding). Normal readers activate areas in the left angular and supramarginal gyri in both real and nonsense words, whereas subjects with dyslexia rely more on cortical areas in the visual cortex during both tasks suggesting greater reliance on automatic word recognition, but poor assembly of phonology. This study suggests similar, rather than distinct, aberrant systems underlie dysphonetic and dyseidetic subtypes. Accurate models of these neuronal networks may prove useful for the development of future drugs or other treatments. This research was supported by NIH/NINDS Grant R01 NS30914.

2-9-9: MEG study of spectral power in expressive language: potential indicator of lateralisation

*NgoC J. Thai1, Peyman Adjamian3, Robert Elwes2, Ian Fawcett1, Paul L. Furlong1, Stefano Seri1, Alison E. Fisher1

1Neurosciences research, Aston University; 2Clinical Neurophysiology, Kings College Hospital London, 3MRC Institute of Hearing Research, Nottingham

In recent years functional imaging studies investigating multiple aspects of language processing have sparked an interest in applying some of the paradigms to various clinically relevant questions, such as the identification of the cortical regions mediating language function in surgical candidates for refractory epilepsy. Previously we have presented data from a group of adult control participants in order to investigate the potential of using frequency specific spectral power changes in MEG activation patterns to establish lateralisation of language function using expressive language tasks (see Fisher et al 2008). Here we report on a group of adult presurgical patient with refractory epilepsy whose language function was assessed with the same verb generation task. The control group consistently produced left hemisphere decreases in beta-band power accompanied by right hemisphere increases in low beta-band power. However, the majority of the patient group only displayed lateralised decreases in beta-band without the accompanying increase in power in the opposite hemisphere. Further investigation is required to establish concordance with invasive measures but our data suggest that the methods described may serve as a reliable lateralisation marker for clinical assessment. Our findings highlight the potential insight that can be gained from MEG investigations of differential neural mechanisms underlying language function between healthy and pathological brain.

Poster: 3-1 MCG: Basic MCG

3-1-1: Magnetocardiography in non-human primate model of cardiovascular diseases

*Naohide Ageyama1,Yusuke Seki2,Kenta Muneyuki3,Akihiko Kondori2,Mikiko Kobayashi1,Keiji Tsukada3,Keiji Terao1

1Tsukuba Primate Research Center, National Institute of Biomedical Innovation 2Advanced Research Laboratory, Hitachi, Ltd. 3Department of Electrical and Electronic Engineering, Okayama University

Cardiovascular diseases (CVDs) such as ischemic heart disease and heart failure represent the leading cause of death and a major health problem worldwide. Large animal models of CVD that reliably mimic human disease are thus required so that the causative mechanisms can be investigated and novel diagnoses established. The close phylogenetic relationship of cynomolgus monkeys to humans has resulted in their widespread use as a preclinical model of CVD. We