Language Changes in Childhood

Organizer: Elizabeth W. Pang

Room: # 104

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Language Changes in Childhood: the Impact of Typical Development, Disease and Therapy

Language is a complex process that undergoes extensive changes with development, is impacted by disease in the brain, and can be rehabilitated with specific treatments. MEG, with its exquisite temporal and spatial resolution, is ideal for tracking language-specific plasticity. The speakers in this symposium will describe the use of MEG to examine these different processes. The first speaker will describe the brain oscillatory changes related to language processing in typically developing children and adolescents. The second speaker will describe a multimodal approach using MEG with fMRI to map language networks in children with epilepsy. The third speaker will present the impact of speech therapy on improving speech outcomes for young children, as captured by MEG. This symposium presents novel approaches to acquiring and analyzing MEG data in children, and emphasizes the valuable contribution of MEG to understanding language plasticity and brain networks.

Speakers:

- **Sam M. Doesburg** (Simon Fraser Univ., Canada)
  "Development of language networks in childhood"

  Synchronization of oscillations among brain areas is thought to mediate communication amongst brain networks involved in cognition, perception, and language. How task-dependent synchronization during word production develops throughout childhood and adolescence remains poorly understood. In this talk, I will present MEG data recorded from children and adolescents while they performed a verb generation task. Task-dependent increases in synchronization were observed in the theta, alpha, and beta frequency ranges, and network synchronization differences were observed between age groups. The theta band showed the strongest task-dependent synchronization and the greatest differences between age groups. Network measures were calculated for brain regions associated with verb generation and were significantly associated with both age and language abilities. These findings are the first to demonstrate an association between network synchronization and measures of individual differences in the development of language abilities. Further, these data establish the maturational trajectory of network synchronization underlying expressive language abilities throughout childhood and adolescence.

- **Darren S. Kadis** (Cincinnati Children's Hospital Medical Center, USA)
  "Multi-modal approach to language mapping in children with epilepsy"

  Children undergoing neurosurgery for treatment of intractable epilepsy are at significant risk for developing functional deficits, including post-operative aphasia. Morbidity can be minimized through careful mapping of eloquent cortex and the epileptogenic zone. Increasingly, clinicians rely on fMRI and MEG to provide presurgical functional maps, particularly for lateralization and localization of language cortex. Noninvasive neuroimaging is safe, cost effective, and repeatable (as necessary). Unfortunately, current fMRI and MEG clinical protocols lack the necessary precision to be used unambiguously in deciding resective margins. Task-related changes in BOLD signal (fMRI) or oscillatory power (MEG) inform of hemispheric or lobar involvement for language, but fail to identify the precise location of critical (i.e., vulnerable) sites from within the distributed language networks of individual subjects. Here, we describe a multimodal neuroimaging pipeline designed to identify critical language sites from patterns of information flux. We will compare maps obtained from MEG effective connectivity analyses to those derived through conventional (invasive) electrocortical stimulation mapping.

- **Vickie Y. Yu** (California State Univ., USA)
  "MEG tracks brain changes related to speech therapy in young children"

  Children with childhood apraxia of speech can benefit from motor speech therapies but the brain mechanism of action has not been extensively explored. The high temporal and spatial resolution of MEG may in helpful in exploring the neural changes related to specific therapies. In this talk, I describe a study where young children, aged 4 years, diagnosed with childhood apraxia of speech were scanned in the MEG before and after an 8 week course of intensive motor speech therapy. MEG analyses identified significant post-therapy changes in brain regions related to oromotor control and speech production. In addition to the findings of the study, I will discuss the challenges of conducting neuroimaging intervention studies in young children.