

BIOMAG 2020

European MEG Society one-day satellite workshop

Investigation of human language with MEG: from research to clinical applications

This one-day satellite workshop aims at giving a novel start to the European MEG Society (EMEGS). After informal contacts with multiple MEG centres across Europe, it appeared clear that people were not interested by having an extra annual or bi-annual MEG conference dedicated to EMEGS. They instead favoured some formal one-day meetings or small symposia organized close to or within other major MEG conferences held in Europe (e.g., BIOMAG, ISACM, MEGUK, MEGNorth or more clinically oriented conferences). This proposition of one-day workshop is therefore the first that is organized in that framework. It is based on the same vein as the Brussels EMEGS one-day symposium done in 2015 about resting state functional connectivity, i.e., a morning session with "fundamental" research oriented talks and an afternoon session with more clinically oriented talks. This is because the link between researchers and clinicians appears as a clear added value compared to the other existing international MEG societies that would foster the translational potential of MEG across Europe. The topic of the proposed workshop (i.e., language) appeared rather consensual and of broad interest for the European (and international) MEG Community that will attend BIOMAG 2020. This one-day workshop will start from a historical and general perspective about what MEG brought to the understanding of the neural bases of human language, and then move on to more advanced research fields investigating the cortical tracking of speech and the development of wearable MEG for language investigations. It will finish by clinical applications of MEG for language presurgical functional mapping and for understanding the pathophysiology of language-related disorders. The workshop will close with a collective discussion about the future of EMEGS aiming at (i) appointing a group of motivated people to develop EMEGS, (ii) establishing the main objectives of EMEGS, and (iii) discussing how EMEGS can play a leading role in the development of a novel concept of scientific society that would be environmentally friendly. We are convinced that this workshop will serve as a potential attractor for BIOMAG2020 with extended attendees recruitment.

PROGRAM

8.30 - 9.00: Welcome

9.00 - 9.15: *Introduction* by Stefan Rampp (University of Erlangen, Germany)

Morning session

Chair: Xavier De Tiège (Université libre de Bruxelles, Belgium)

9.15 - 10.00: *Magnetoencephalography measures as probes of language processing*

Speaker: Riitta Salmelin (Aalto University, Finland)

Abstract: After nearly three decades of work, we know what kind of magnetoencephalography (MEG) responses to expect in basic language paradigms, such as spoken and written word perception and picture naming. Based on this groundwork, it has been possible to address neural correlates of language development, learning and disorders, and even begin to elucidate brain organization of meaning and knowledge. In this endeavour, it has become evident that the choice of imaging measures can importantly influence the way we interpret brain function. MEG evoked responses, oscillatory power and connectivity at neural time scales, as well as the slower haemodynamic measures of activation and interareal correlations available using functional magnetic resonance imaging (fMRI), allow complementary views to language processing. Together, these various measures can offer rich possibilities to multiview imaging that will reach beyond mere combination of location and timing of neural activation. Strengthened by advanced machine learning approaches, they promise to uncover the organizational principles of language function in the human brain.

10.00 - 10.40: *Top-down and bottom-up processing in cortical entrainment to continuous speech*

Speaker: Hyojin Park (University of Birmingham, UK)

Abstract: Prior studies have shown that brain rhythms track acoustic envelope in auditory speech (reactive speech entrainment in a bottom-up manner) and speech comprehension is enabled by the ability to predict upcoming speech inputs in a given context (proactive top-down processing). However, to what extent top-down and bottom-up signals are orchestrated in speech comprehension still remains uncovered. In my talk, I will give an overview of what has been found for proactive and reactive processing in speech comprehension in terms of space (brain regions) – time (temporal evolution) – frequency (oscillatory activities matching speech components). Furthermore, I will discuss how attention modulates the information flow of the neural responses.

10.40 - 11.10: coffee break

11.20 - 11.50: *Developmental trajectory of the cortical tracking of speech in noise and link with literacy*

Speaker: Mathieu Bourguignon (Université libre de Bruxelles, Belgium)

Abstract: During connected speech listening, oscillatory activity within auditory cortices tracks speech rhythmicity at syllable, word and phrasal rates. In adults, such cortical tracking of speech is also observed in speech-in-noise (SiN) conditions, and in that context, oscillatory brain activity aligns more to the attended speech than to the heard sound. This talk will present recent studies that addressed (i) the neuronal basis of the well-described behavioural difficulty of children to perceive SiN, (ii) the impact of noise properties and audiovisual integration on SiN perception in children and adults, and (iii) the relation between SiN perception and reading abilities in children.

11.50-12.20: *Language mapping and optically pumped magnetometers*

Speaker: Tim Tierney (University College of London, UK)

Abstract: Optically Pumped Magnetometers have emerged as wearable alternative to traditional cryogenic magnetoencephalography. They offer the promise of improved SNR and spatial resolution in a reduced form factor. In principle, such a system should be incredibly useful in the context of neuroimaging. I will critically evaluate these points in the context of mapping Language networks while highlighting the clinical relevance of this new technology.

12.20-13.00: lunch

Afternoon Session

Chair: Riitta Salmelin (Aarhus University, Denmark)

13.00 - 13.45: *MEG assessment of expressive language in neurosurgical patients*

Speaker: Elaine Foley (Aston University, UK)

Abstract: Establishing language dominance is an important step in the presurgical evaluation of patients with refractory epilepsy or focal brain lesions. Initial reports on MEG language localization have shown encouraging results with a wide variety of cognitive paradigms and analysis strategies. A brief overview of these studies will be provided, with a specific focus on how task-related time-varying changes in the electromagnetic power spectrum can be used to detect hemispheric dominance for language. The potential value of applying task-based measures of MEG network synchronization and network topology to identify critical regions of the language network will be discussed.

13.45 - 14.15: *Impaired auditory entrainment following speech edges in dyslexia.*

Speaker: Nicola Molinaro (Basque Center on Cognition, Brain and Language, Spain)

Abstract: Previous studies have shown that speech is encoded in part via the entrainment of neural oscillations by temporal modulations in the speech signals. Numerous studies suggested that phonological deficits in dyslexia may be linked to atypical neural entrainment to the speech rhythms. Using MEG, we analyzed the neural entrainment during the processing of speech edges in normal and dyslexic readers. Both groups showed neural entrainment to speech edges at low frequencies (<10 Hz) in bilateral auditory regions. Importantly, we found that dyslexic readers showed weaker entrainment compared to normal readers in left auditory regions. Our findings are consistent with temporal sampling theory for developmental dyslexia and current neural accounts of speech encoding.

14.15- 14.45: *MEG indicators of atypical auditory language processing in developmental language disorders*

Speaker: Tiina Parviainen (University of Jyväskylä, Finland)

Abstract: Disorders of language development are associated with varying levels of impairment in auditory function and spoken word processing in the brain. Intact processing of auditory language is essentially dependent on the recruitment of needed cortical processes in a correctly timed manner. I will review our MEG studies that characterize the time-course of auditory (and visual) language perception and comprehension in typically and atypically developed brain. Our results indicate distinct anomalies in the auditory language processing pathway in specific language impairment (developmental language disorder) and dyslexia. Comparing the cortical resources utilized in auditory language processing in typically developed and compromised learners highlight especially the role of left hemisphere auditory areas and/or age-appropriate interhemispheric balance between hemispheres for competent language development.

14.45 - 15.00: Neural bases of auditory central disorders: how speech processing is impaired in adverse auditory scenes ?

Speaker: Marc Vander Ghinst (Université libre de Bruxelles, Belgium)

Abstract: Patients encountering speech perception in noise impairment without any observable peripheral hearing deficit (SPiNI) is a common clinical situation. Despite a prevalence exceeding 5% of the adult population, SPiNI pathophysiology remains largely unknown. We will here present recent data demonstrating the alterations in cortical tracking of speech in adverse auditory scenes combined with altered functional connectivity in the language networks observed in patients with SPiNI.

15.00 - 15.30: coffee break

15.30 – 15.45: Conclusions

15h45 – 16h30: *Discussions about the future of the European MEG Society*

Moderators: Stefan Rampp and Xavier De Tiège

16.30: END of the workshop