

MEG in Infant Auditory Neuroscience

T. Christina Zhao

I-LABS, University of Washington

April 2019 at NTU

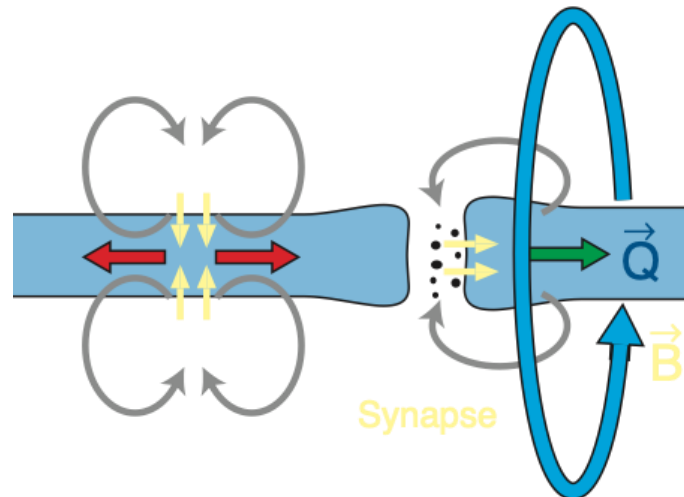
Today's Topics

- MEG Basics
- Infant Limitations
- What has been done using MEG to study infants' speech learning?
- What's in the future?

MEG Basics

- The signal
 - Action vs. Postsynaptic Potentials

Current configurations

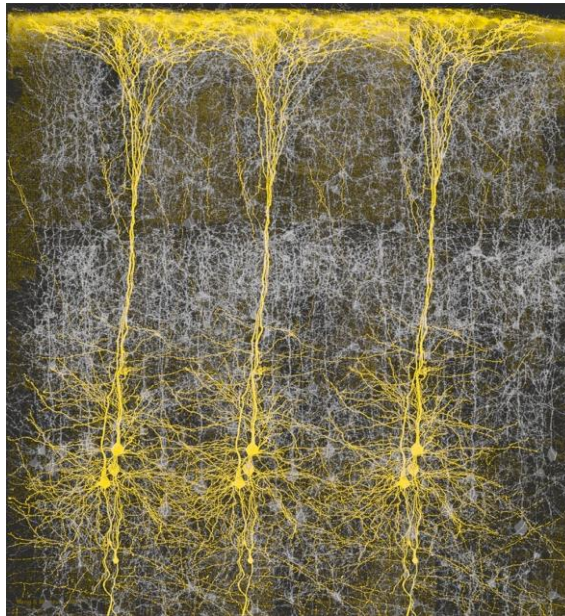


Action currents Postsynaptic currents

Courtesy of Matti Hämäläinen

MEG Basics

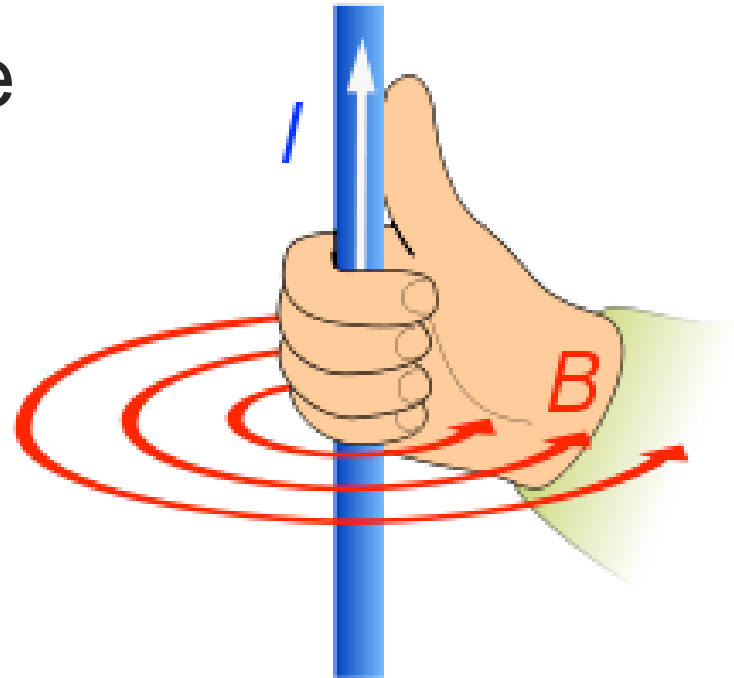
- The signal
 - Pyramidal Cells



Courtesy of Matti Hämäläinen

MEG Basics

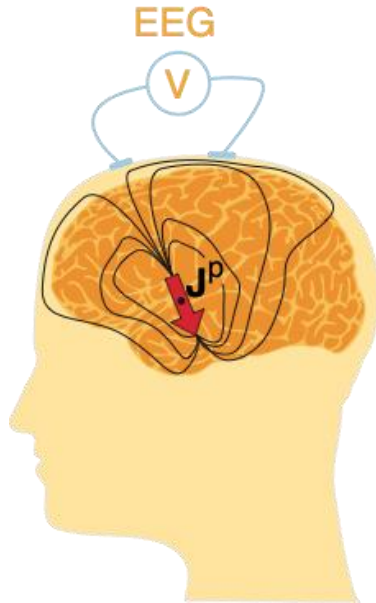
- The signal
 - Right-Hand Rule



Courtesy of Adrian KC Lee

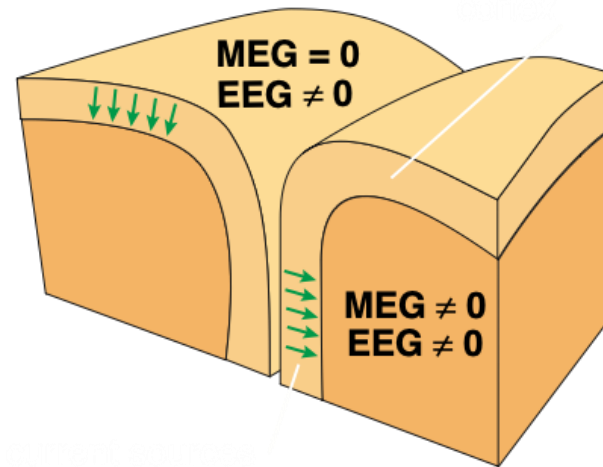
MEG Basics

- EEG vs. MEG signals



“MEG sees less, but sees more clearly.”

- David Cohen, MEG inventor



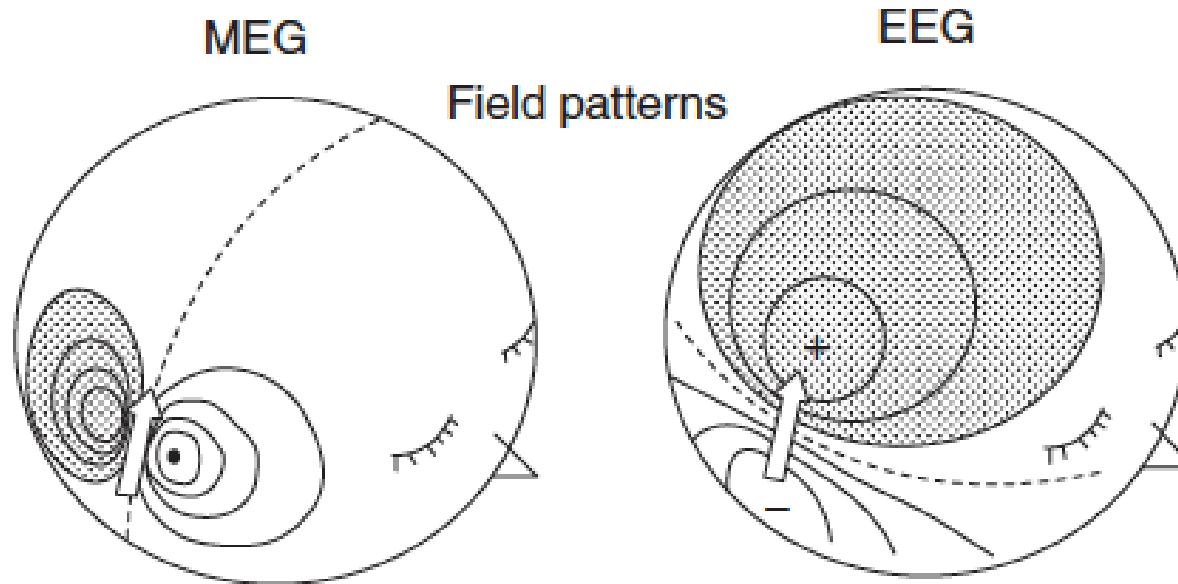
Courtesy of Matti Hämäläinen

MEG Basics



- EEG vs. MEG signals

Magnetoencephalography versus Electroencephalography



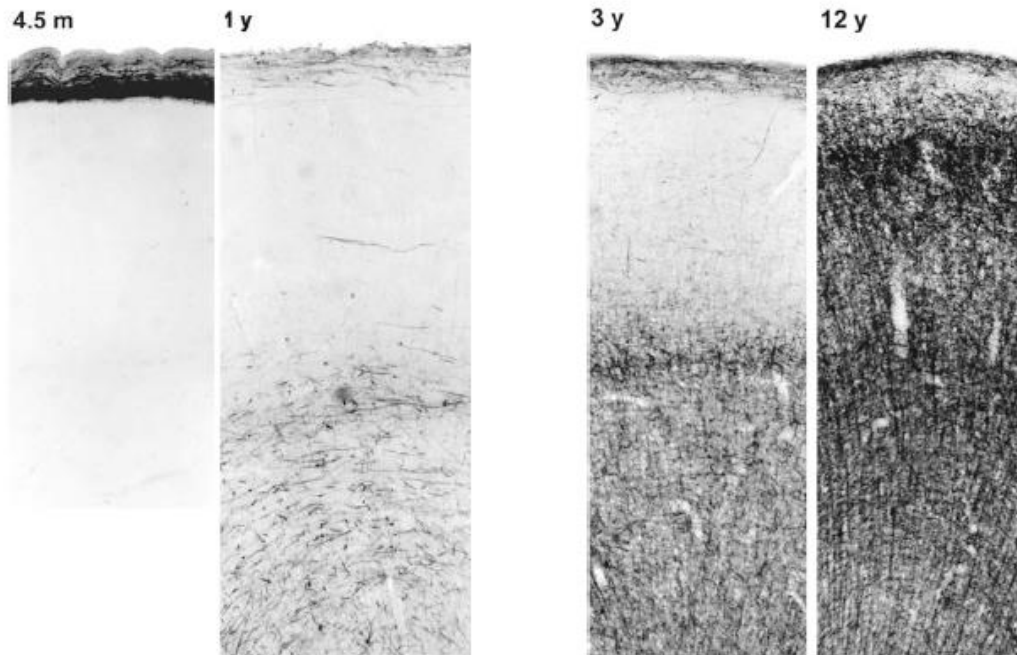
A large, semi-circular inset on the left side of the slide shows a microscopic image of neurons. The neurons are depicted with their cell bodies and a dense network of branching processes (dendrites and axons) in shades of light blue and white against a darker blue background. The inset is partially obscured by a dark blue circle.

Questions?

Infant Limitations

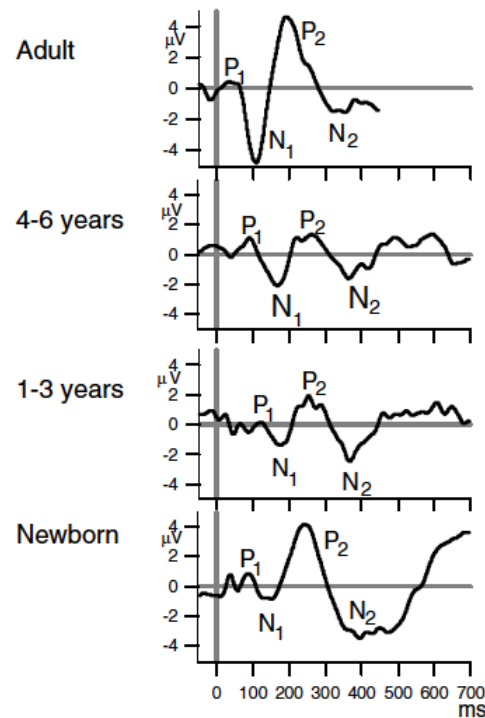


- Lower neuron density



Infant Limitations

- Weaker and more sluggish signal



Infant Limitations

- More difficult to reconstruct brain surface from MRI scan (lack of contrast due to underdeveloped white matter)



Infant Limitations

- More difficult to reconstruct brain surface from MRI scan (lack of contrast due to underdeveloped white matter)



Infant Limitations



- Measurement noise (Movement)



Infant Limitations

- Difficulty in taking measurement (show video of digitization?)



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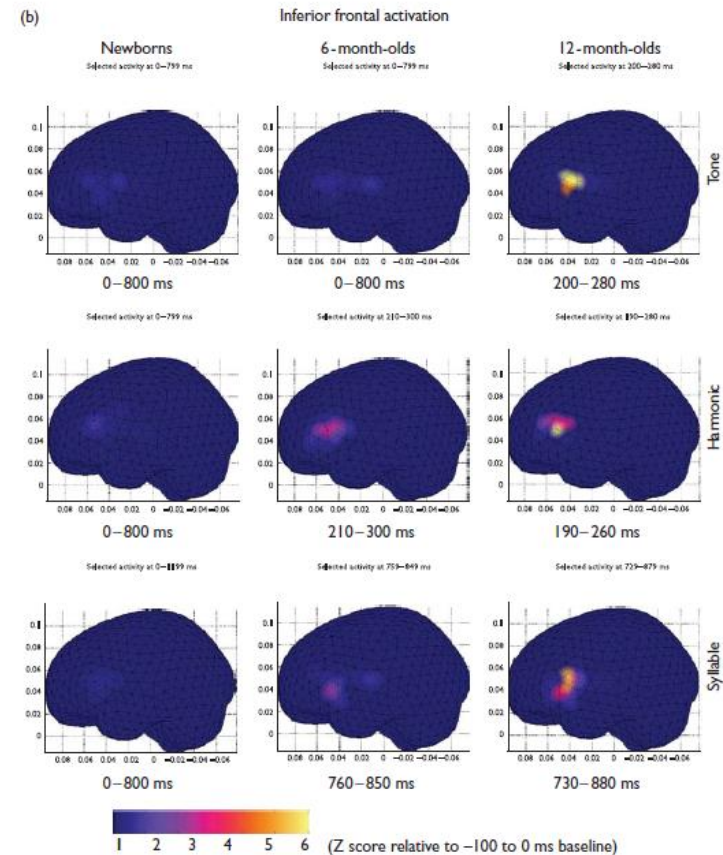
What we have done in infant population



- Using the more traditional Event-Related method, MEG studies have provided new insight into the ‘perceptual narrowing’ period in infants’ speech learning

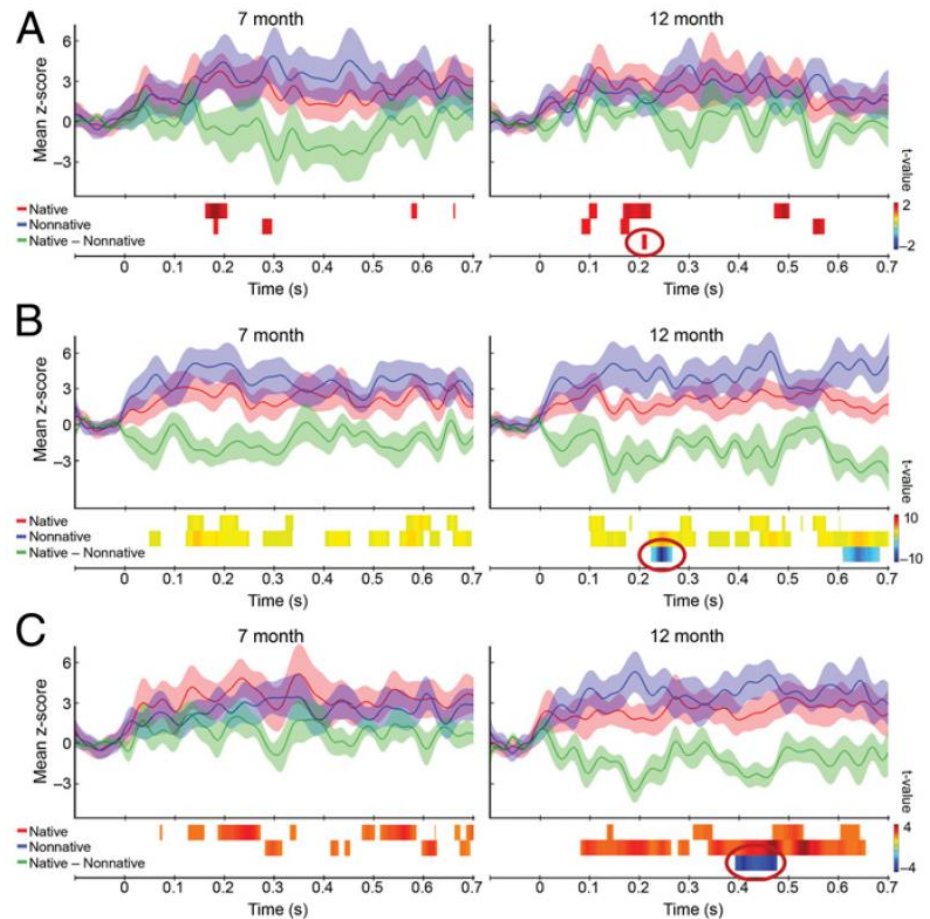
What have been done in infant population

- Mismatch Response Observed in Older Infants for Tones and Syllables in inferior frontal regions (Imada et al., NeuroReport, 2006)



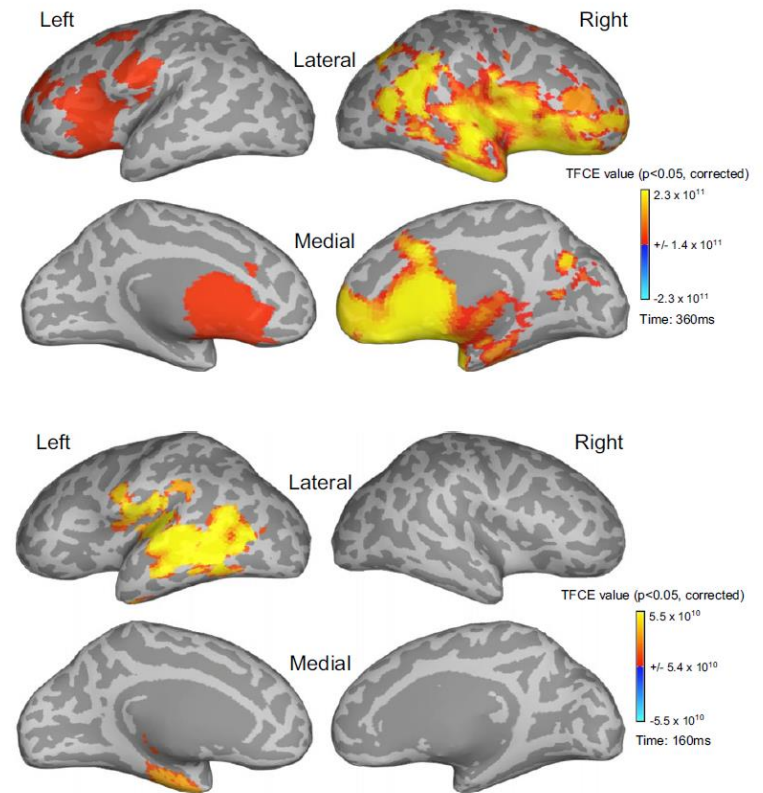
What have been done in infant population

- MMRs become different for native and nonnative speech contrast at 12 months of age (Kuhl et al., PNAS, 2014)



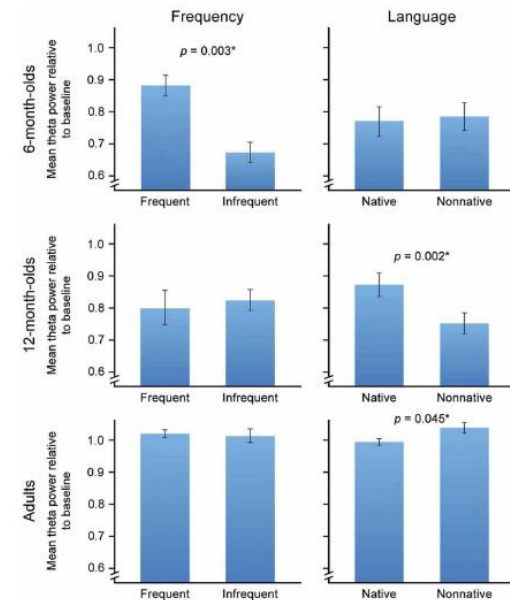
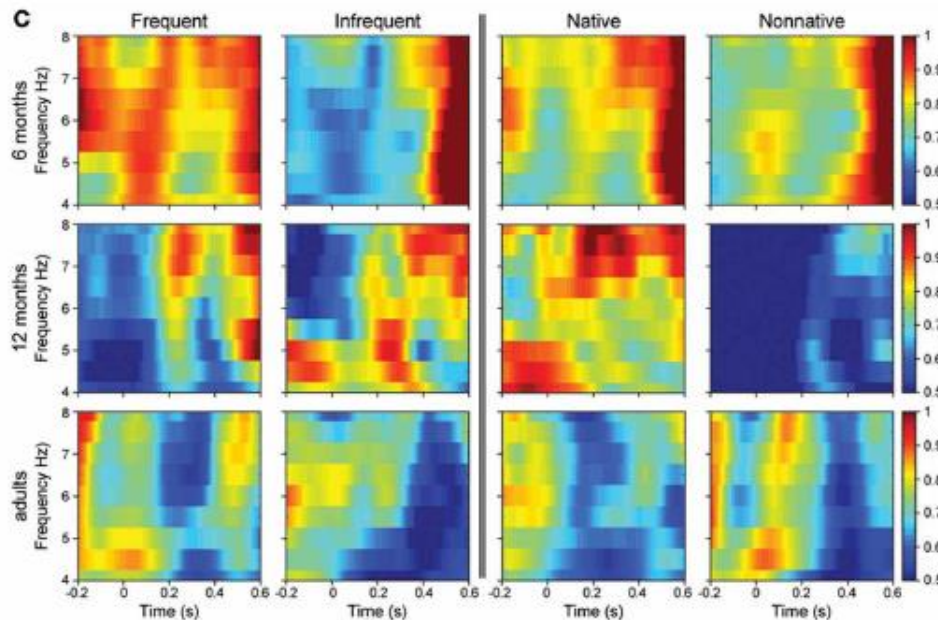
What have been done in infant population

- Compared monolingual and bilingual infants' MMR towards English and Spanish contrasts (Ferjan Ramirez et al., Dev Sci, 2017)



What have been done in infant population

- There is also explorations in using analysis methods in the frequency domain (Bosseler et al., Frontiers, 2013)



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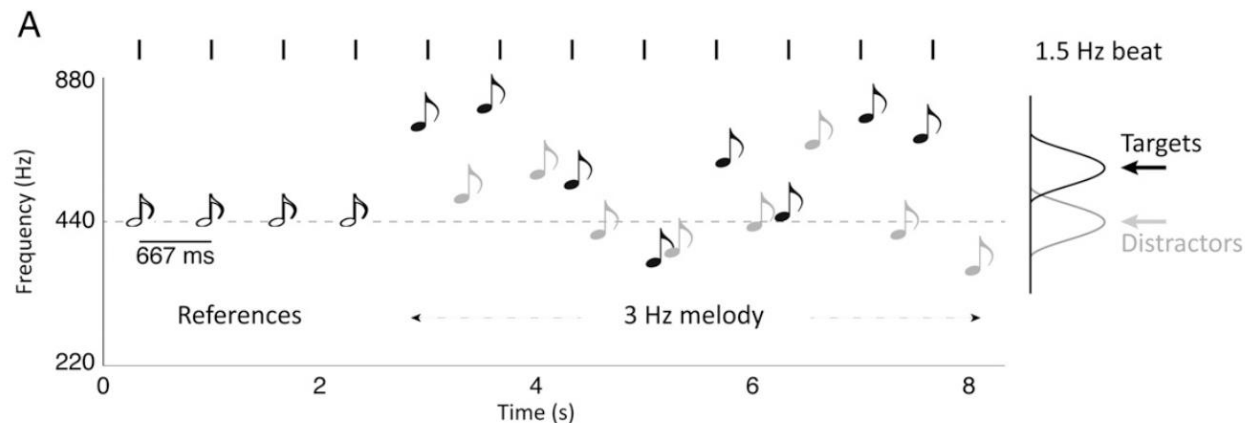
Future methods

- Coherence methods
 - Currently widely used in adults but not yet in infants given the limitation we discovered (but on the horizon!)
 - Here we discuss two approaches that has been used in adults to address some auditory neuroscience questions

Future methods

- Coherence methods

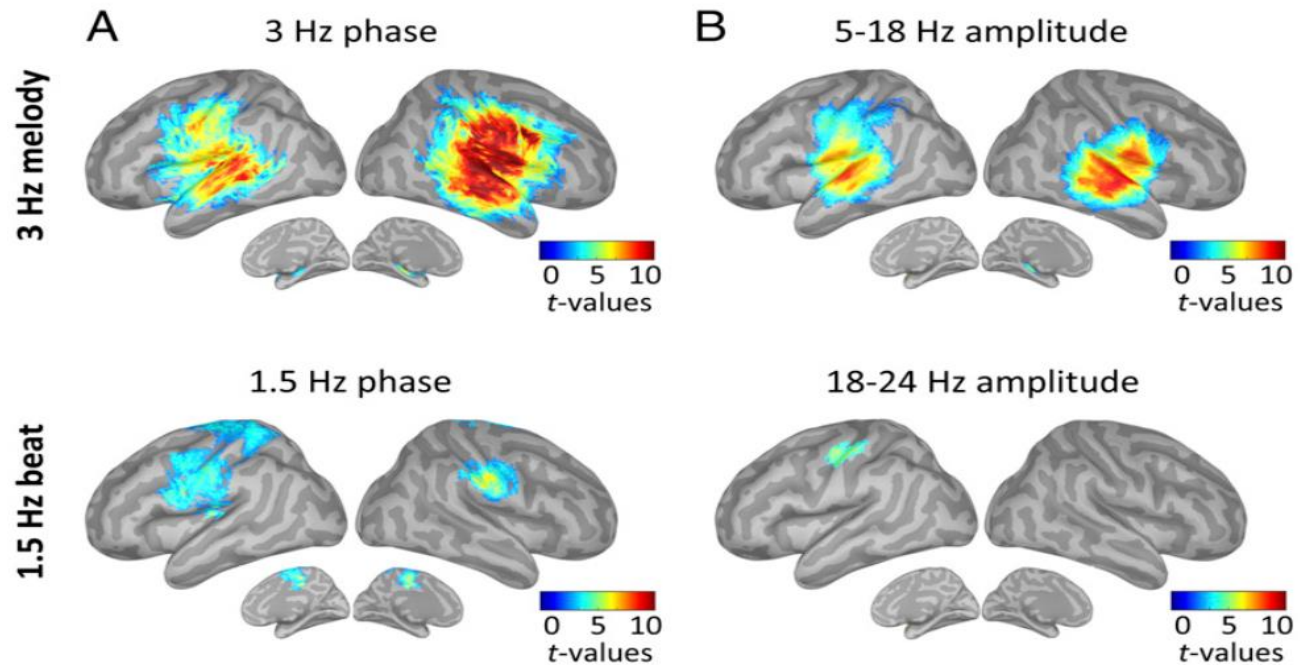
- Stimulus-Response coherence (Morillon & Baillet, PNAS, 2017)



Future methods

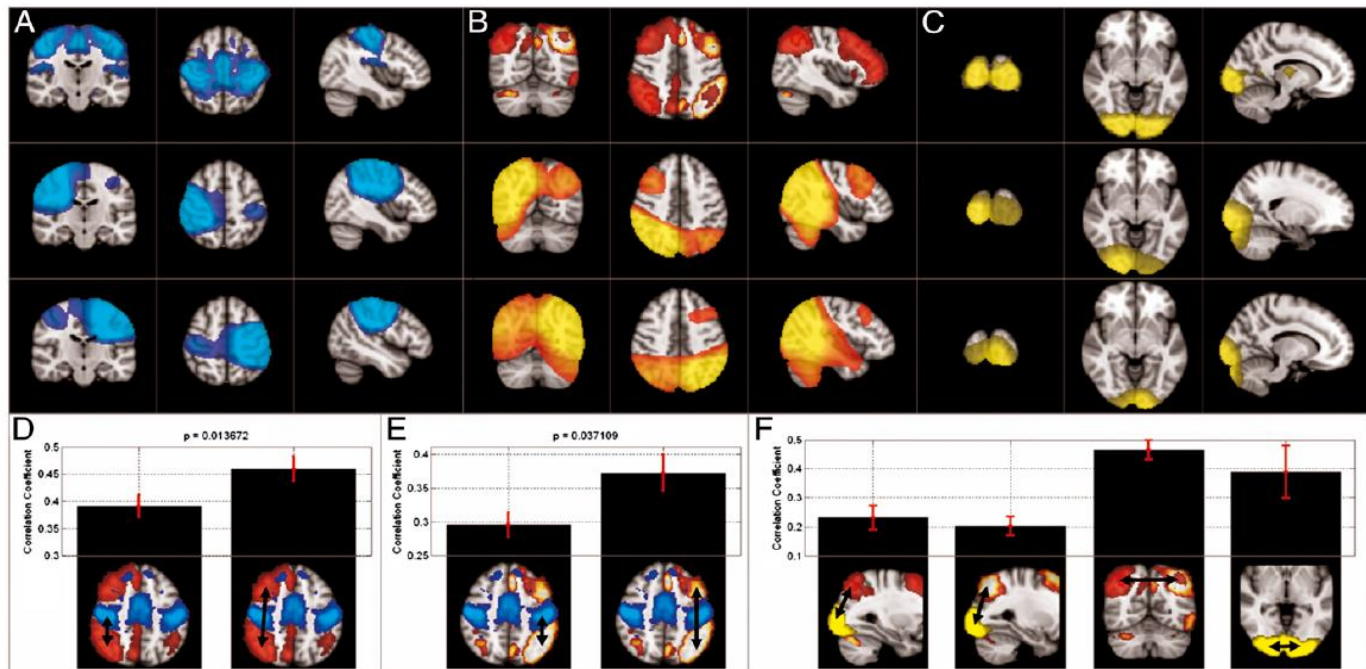
- Coherence methods

- Stimulus-Response coherence (Morillon & Baillet, PNAS, 2017)



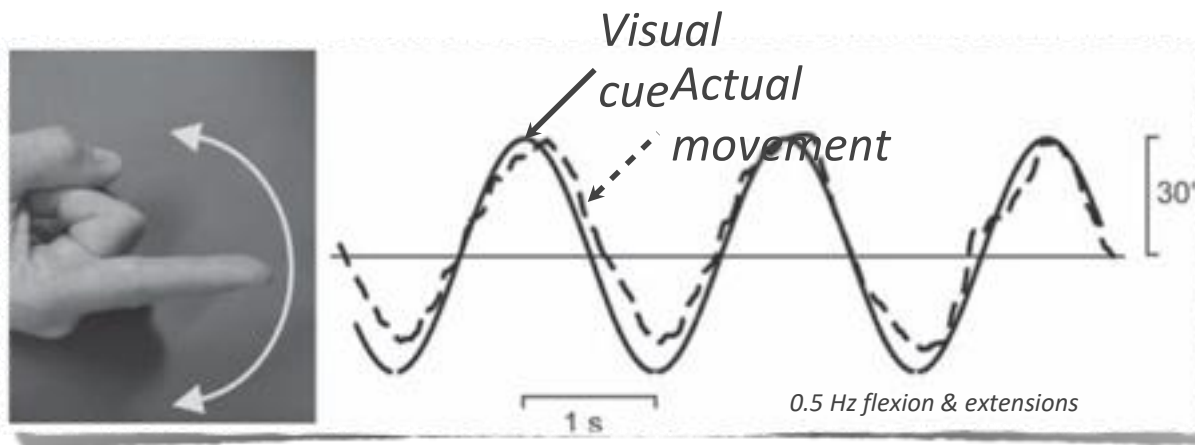
Future methods

- Coherence methods
 - Cross-regional coherence
 - Resting-network (Brookes et al., PNAS, 2011)



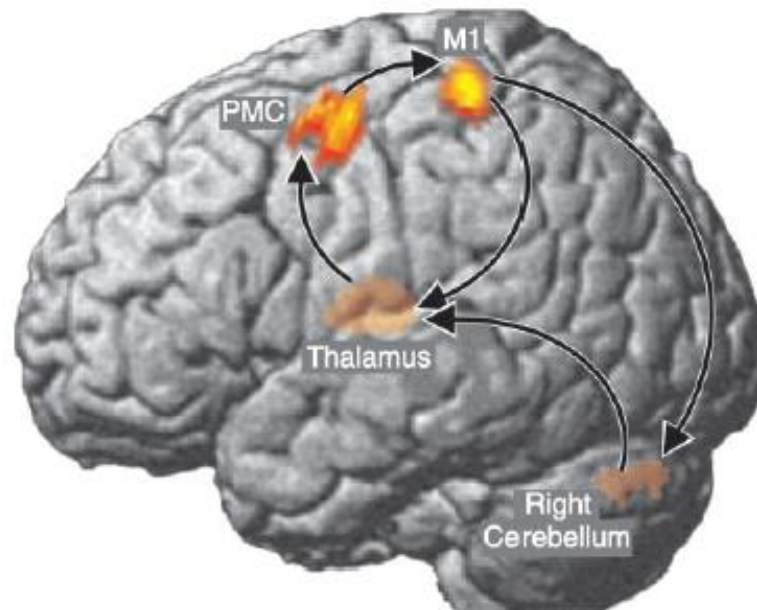
Future methods

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 - Cross-regional coherence
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Questions?