I knew you were going to say that: neural measures of predictive speech processing in people with autism.

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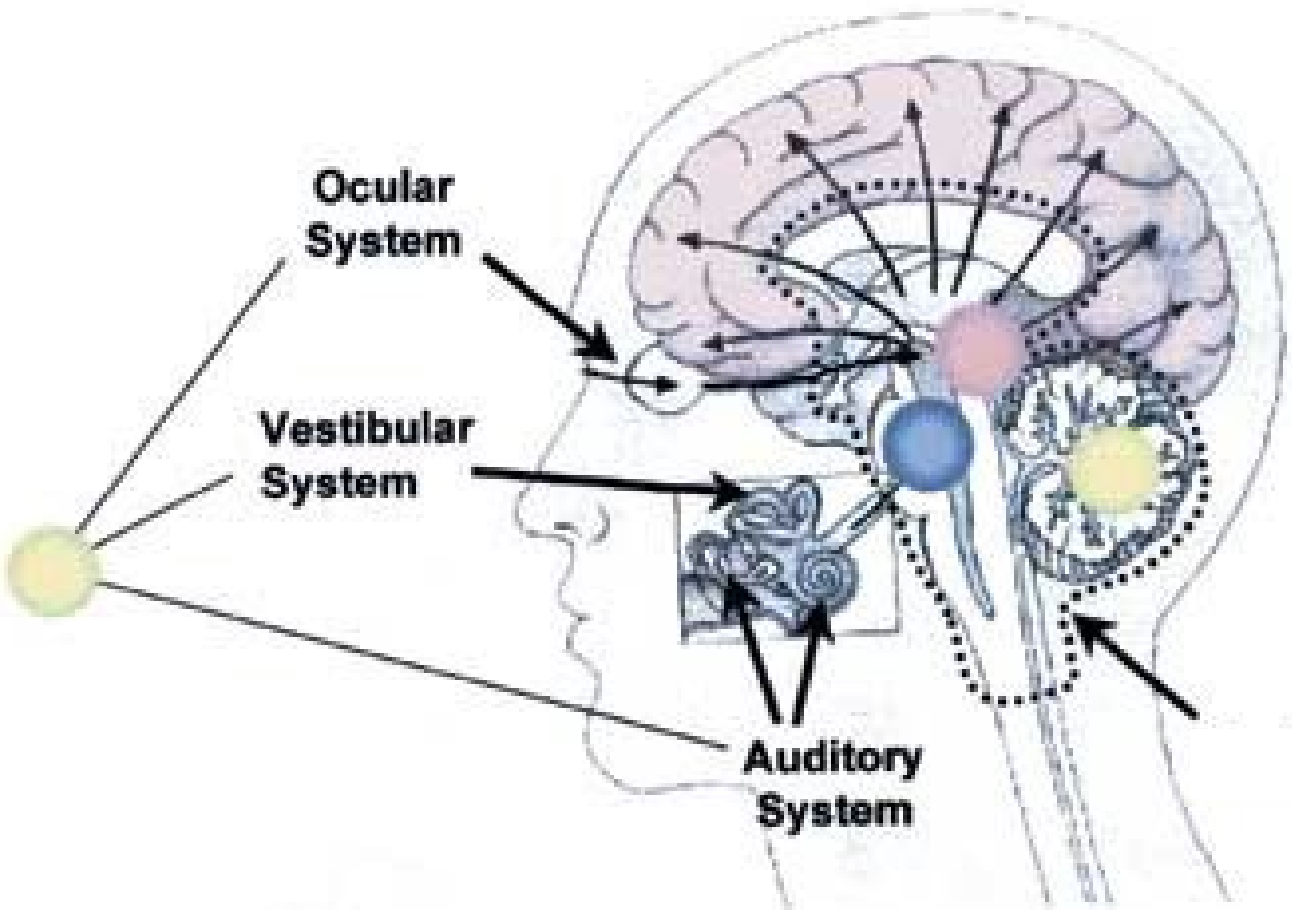
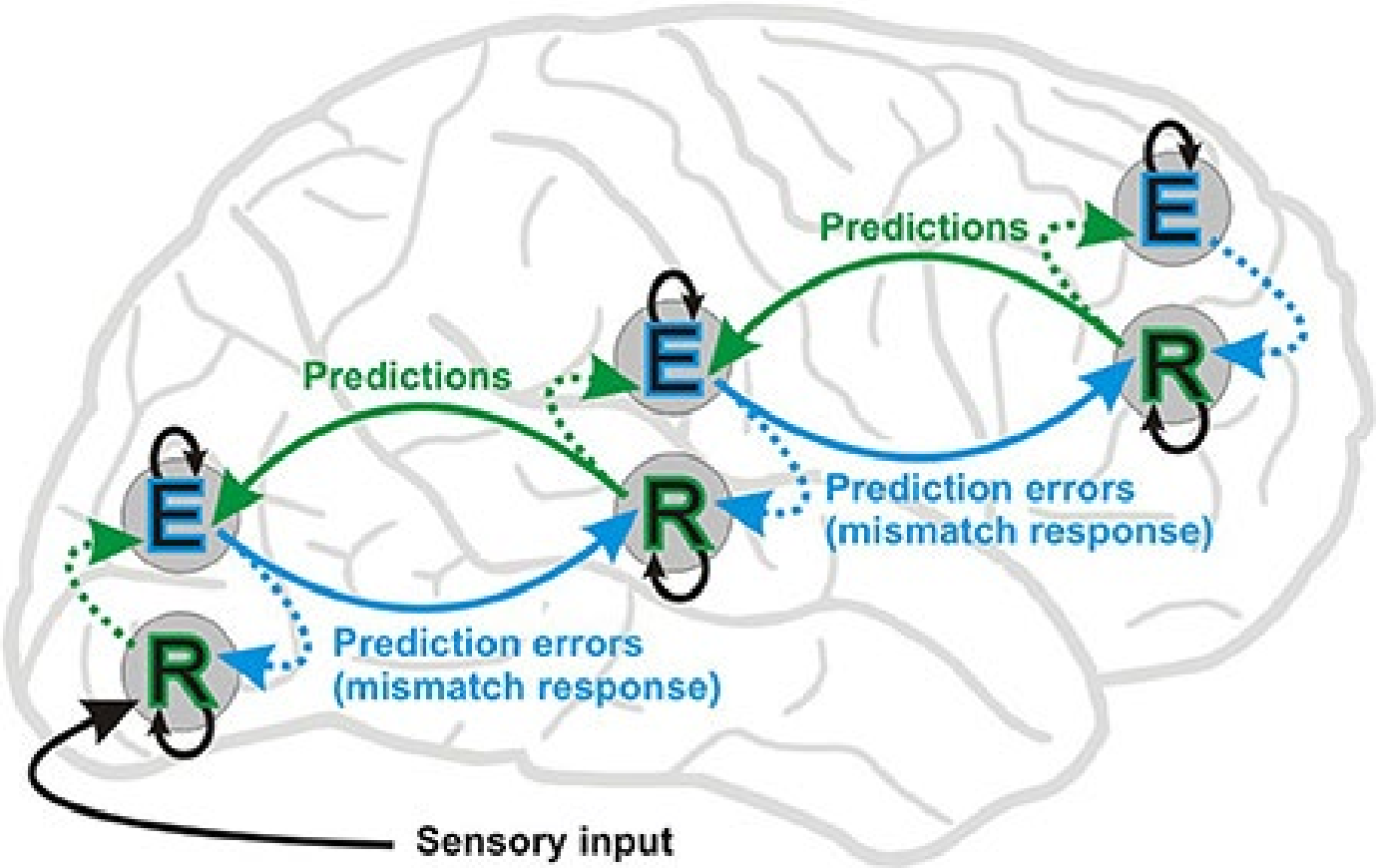
Skirboll Family Autism Conference November 3, 2022

Sensory Processing in the Brain



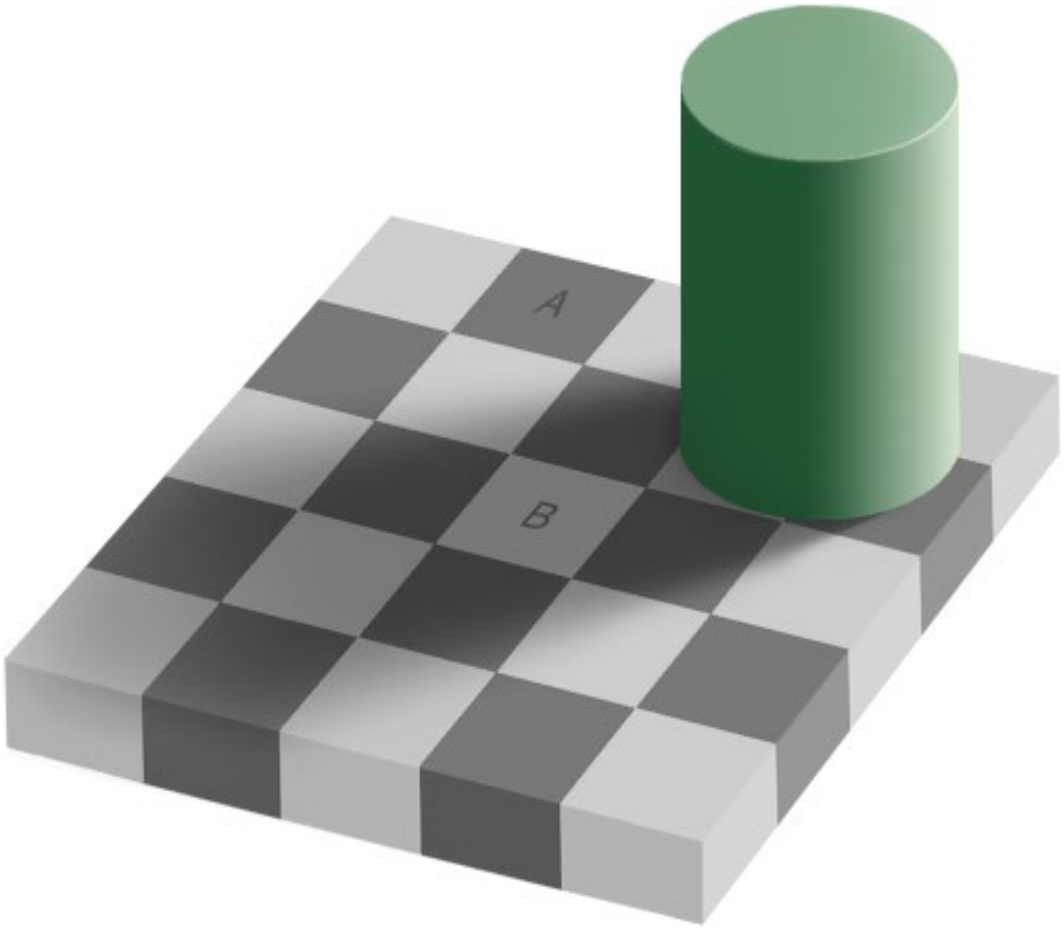
The Classic View

Predictive Processing in Cortex



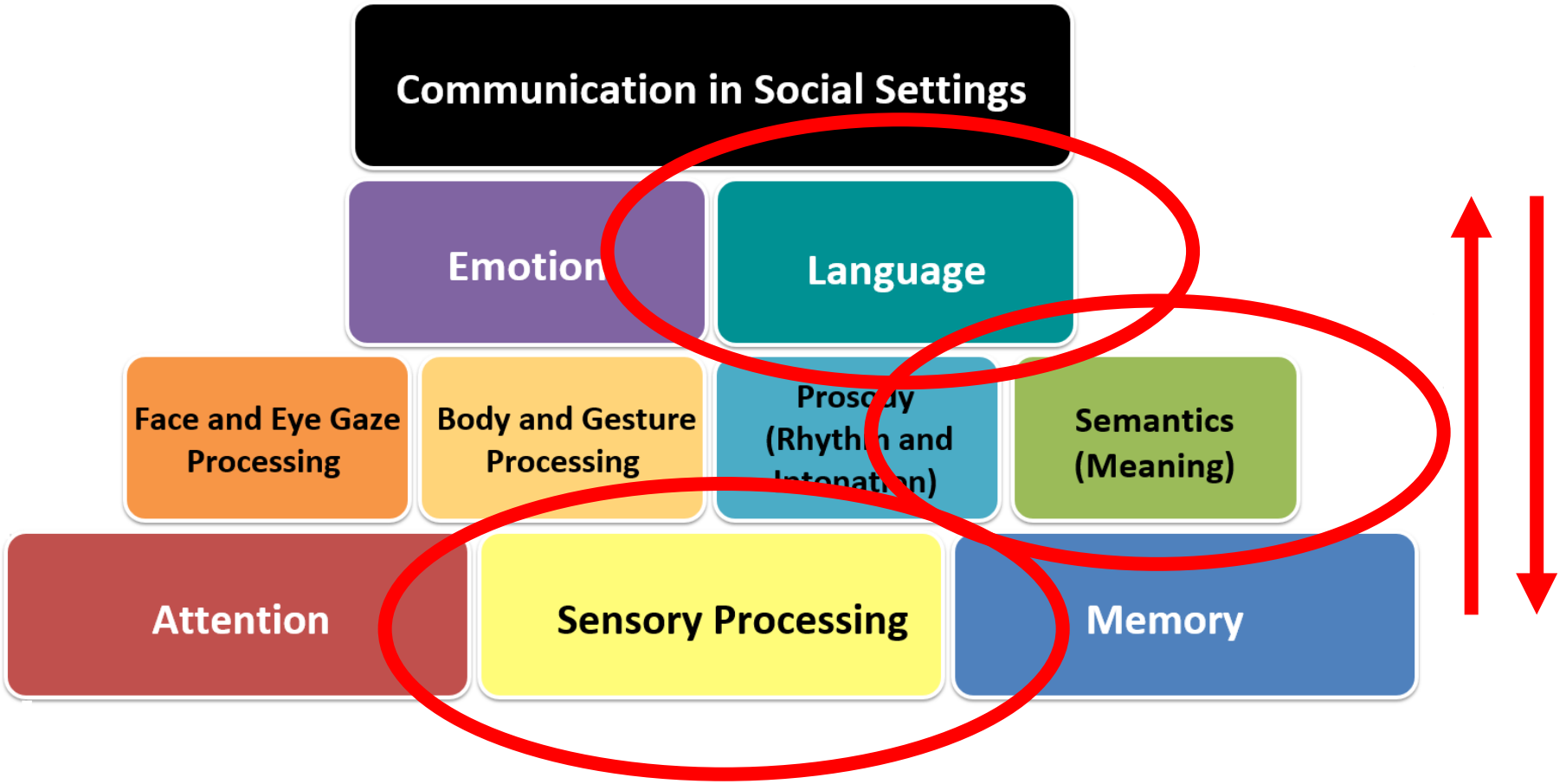
Stefanics et al. 2014

Predictive Processing in Cortex



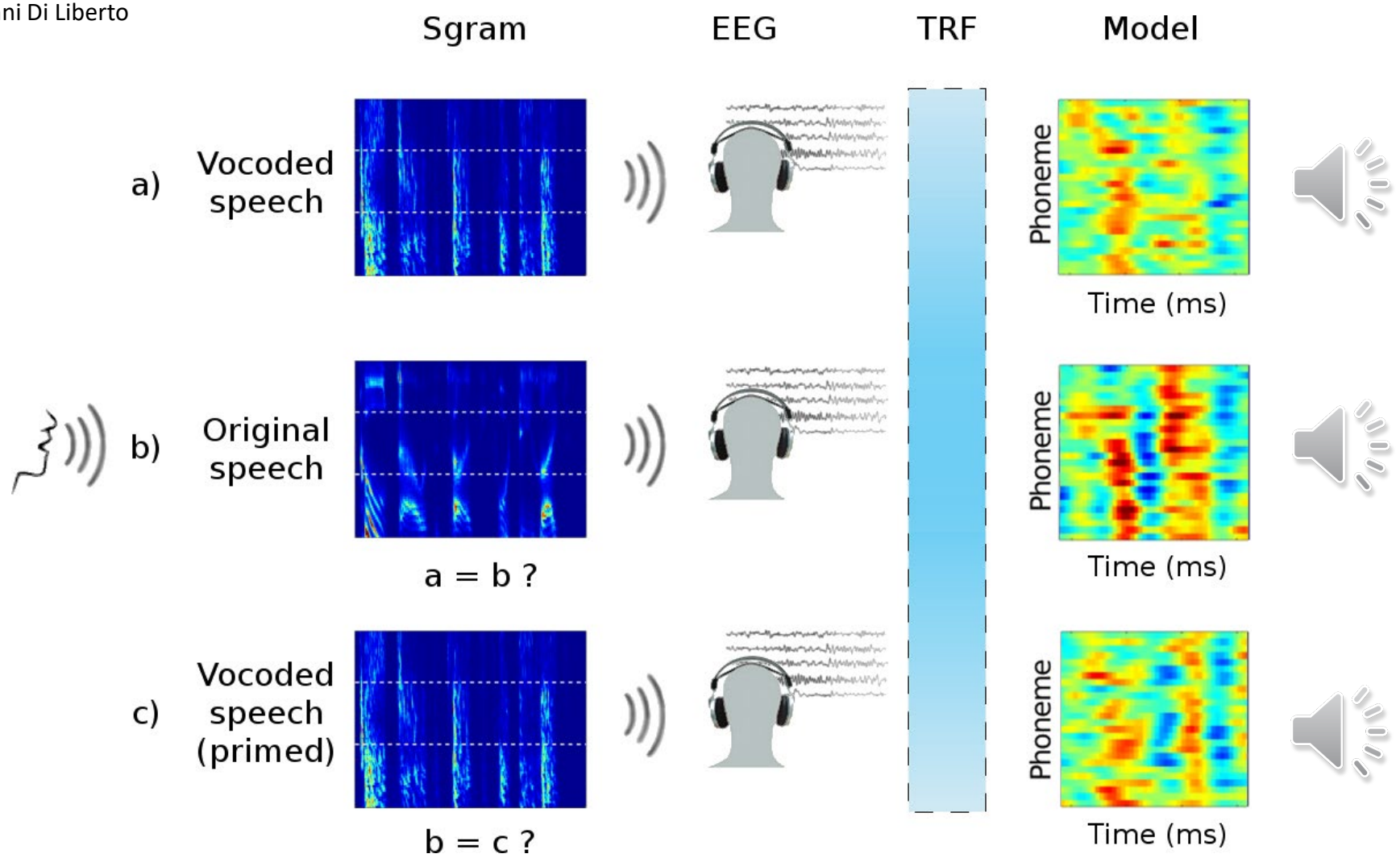
Adelson

Predictive Processing in Cortex



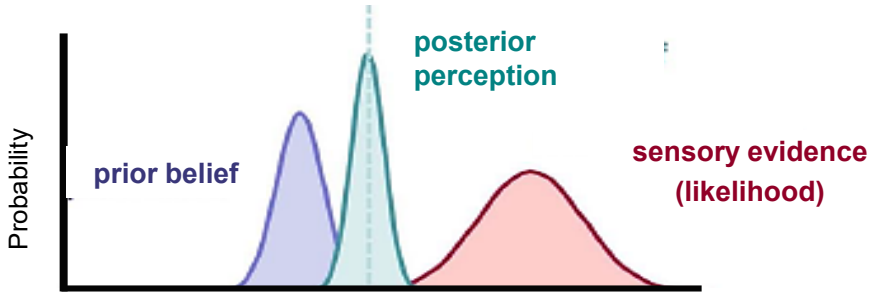
Giovanni Di Liberto

Isolating neural indices of continuous speech processing at the phonetic level

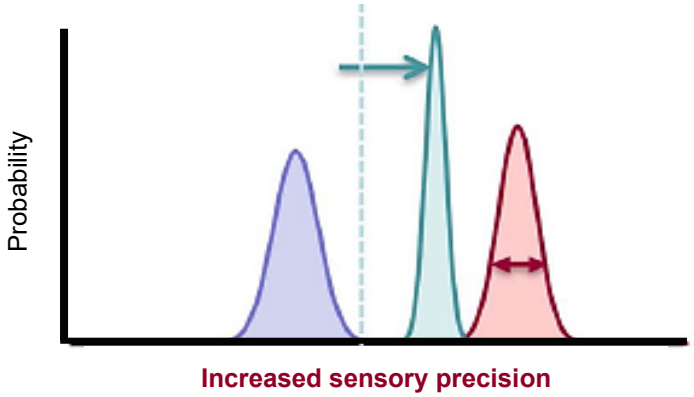


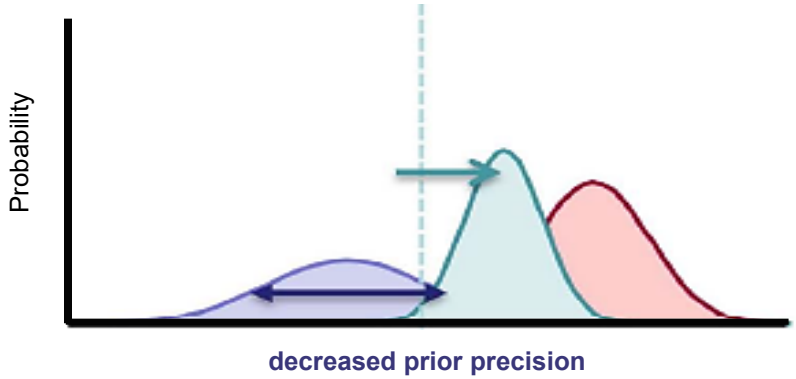
Di Liberto, Crosse, Lalor, *eNeuro*, 2018

Predictive Processing in Cortex



We infer the causes of sensory input by combining that input with our learned/evolved model of the world





Horga and Abi-Dargham 2019, Adams 2018, Sterzer 2018, Friston 2010, Lupyan and Clark 2015

Predictive Processing in Cortex

Autism

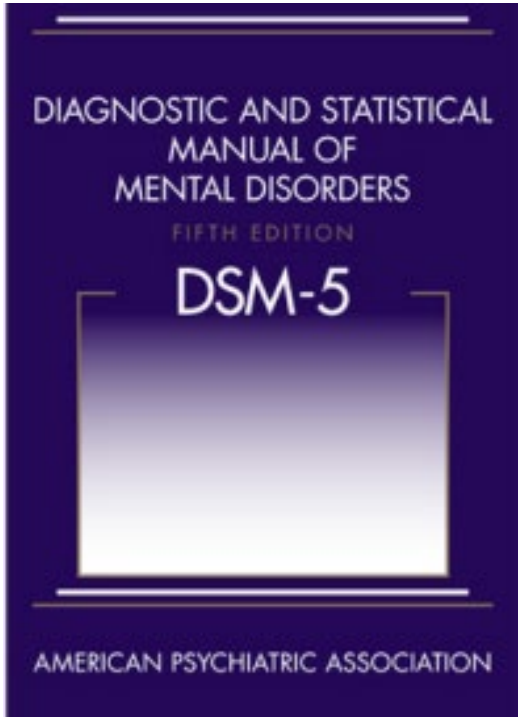
- Enhanced pitch perception, hypersensitivity to loud sounds, and impaired auditory stream segregation *(O'Connor, 2012)*

- Aberrant precision account *(Lawson et al., 2014)*

Schizophrenia

- Auditory hallucinations

- Weakened prediction errors and increased auditory cortex activity *(Horga et al., 2014).*



SFARI SIMONS FOUNDATION AUTISM RESEARCH INITIATIVE

SFARI Pilot Grant:

Perception and Language in Autism Spectrum Disorder: assessing the role of predictive processing in ASD using electrophysiological modeling of neural responses to natural speech.

- Aim 1: Neurotypical Adults

- Aim 2: Adolescents/Young Adults with and without a diagnosis of ASD

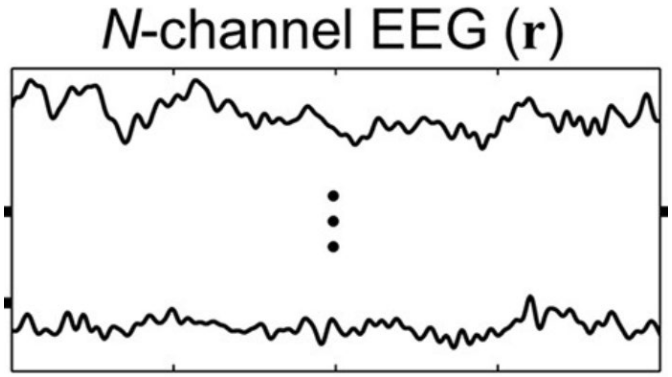
Using EEG study speech processing

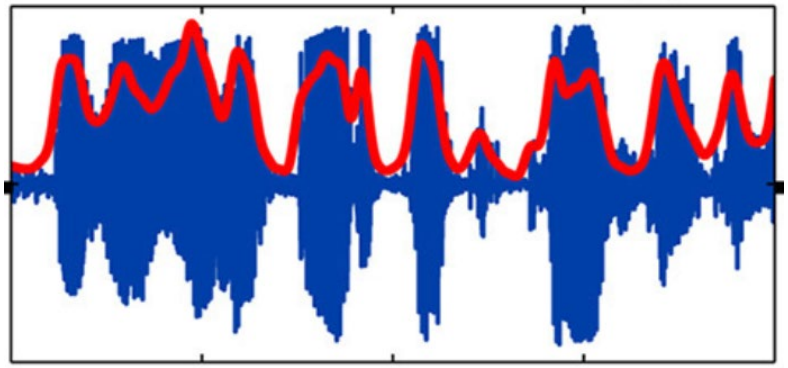
Neural activity tracks dynamics of natural speech

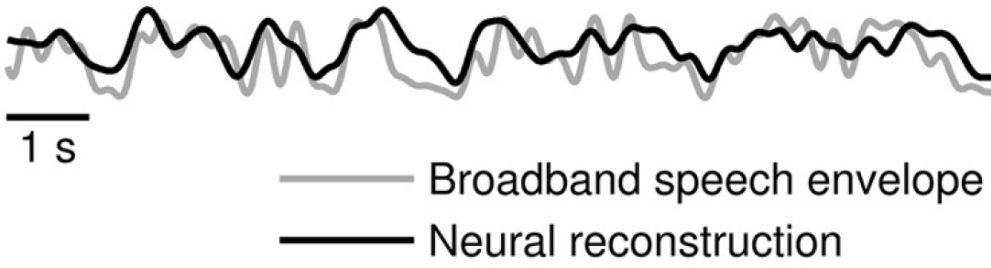
Recorded EEG "brainwaves"

fluctuate in a way that is correlated with

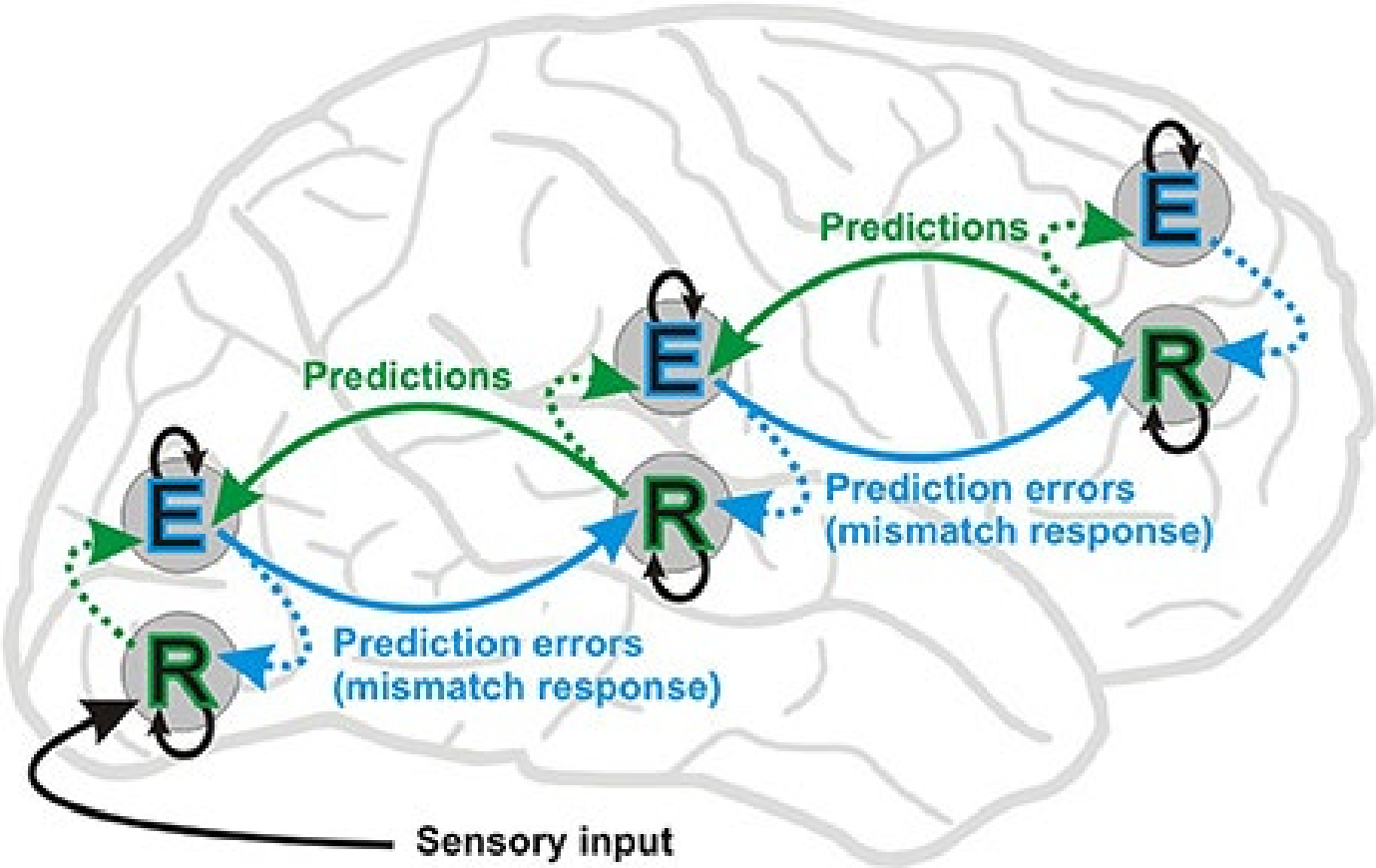
fluctuations in speech energy







Predictive Processing in Cortex

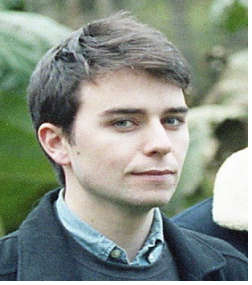


Stefanics et al. 2014

Predictive Processing of Natural Speech

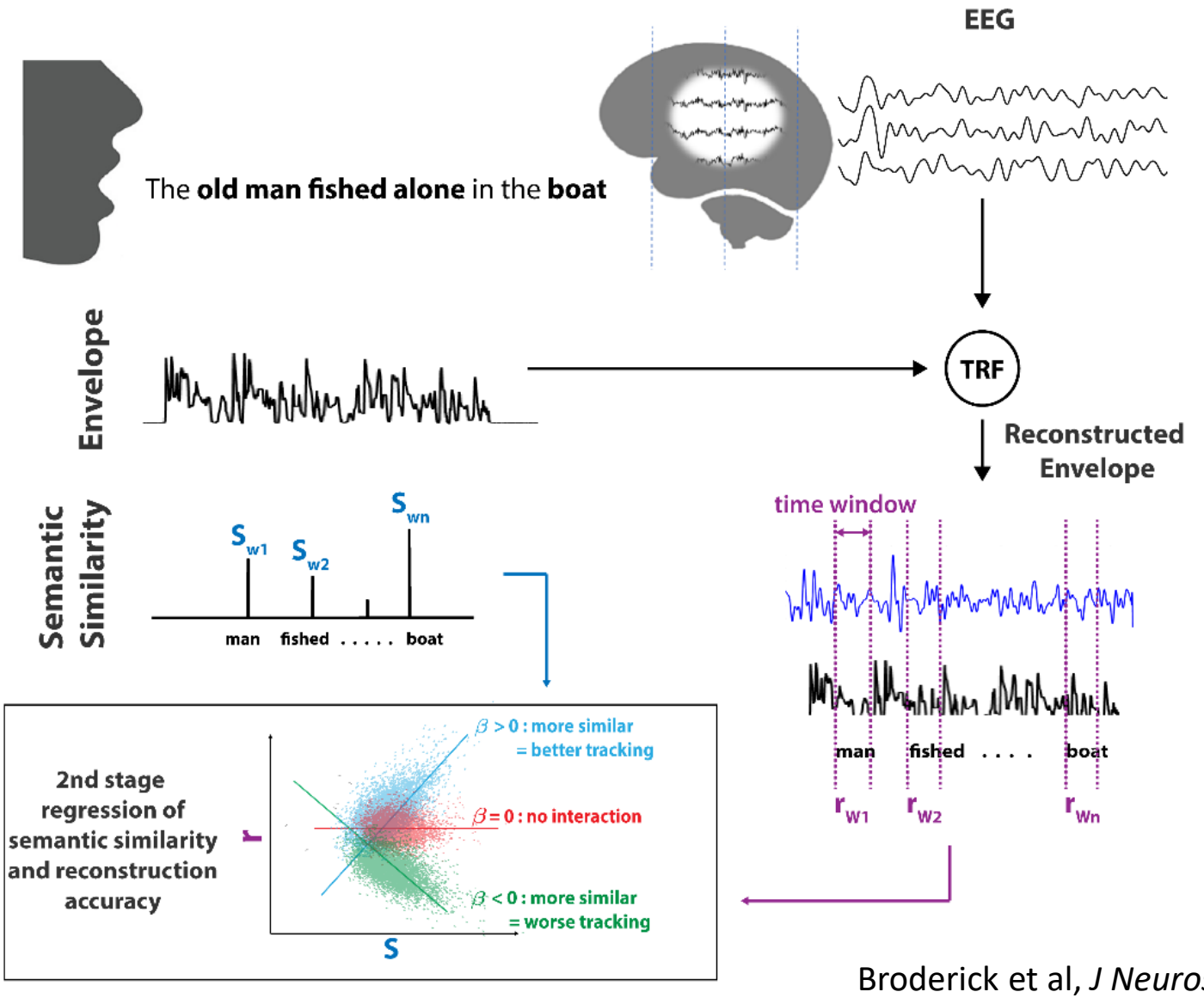
- I take my coffee with cream and…
- The dentist told me to brush my…

- Yesterday on my way to work I saw a…
- Recently I read a book about…

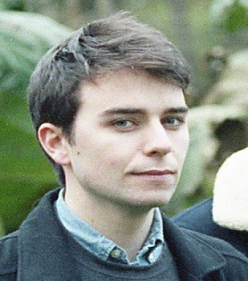


Michael Broderick

Semantic Context Enhances the Early Auditory Encoding of Natural Speech



Broderick et al, *J Neurosci*, 2019



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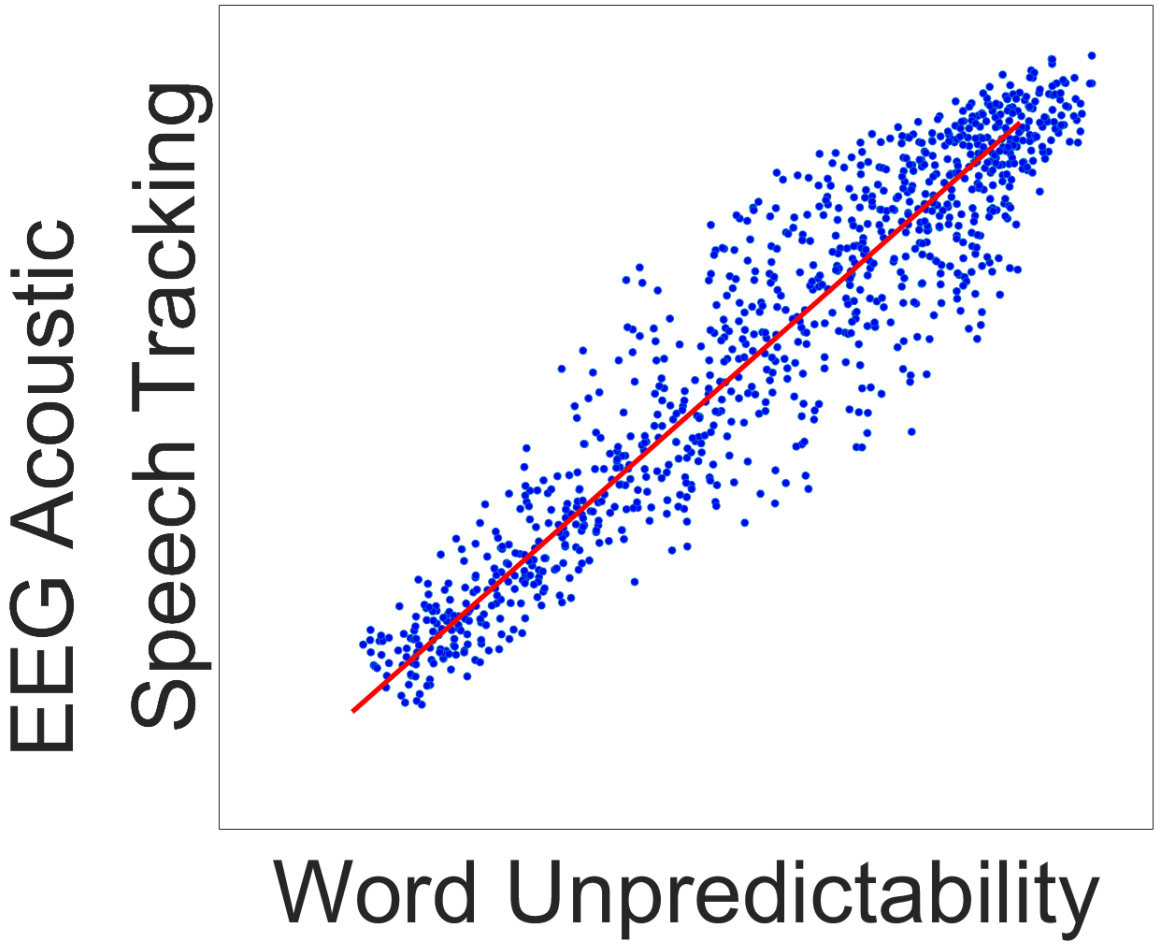


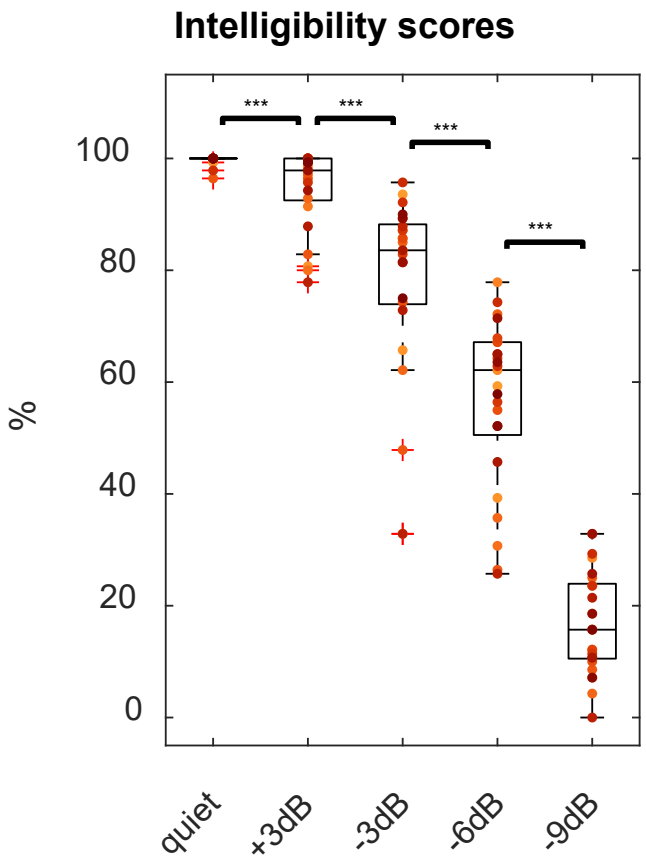
Broderick et al, *J Neurosci*, 2019

Using EEG study speech processing

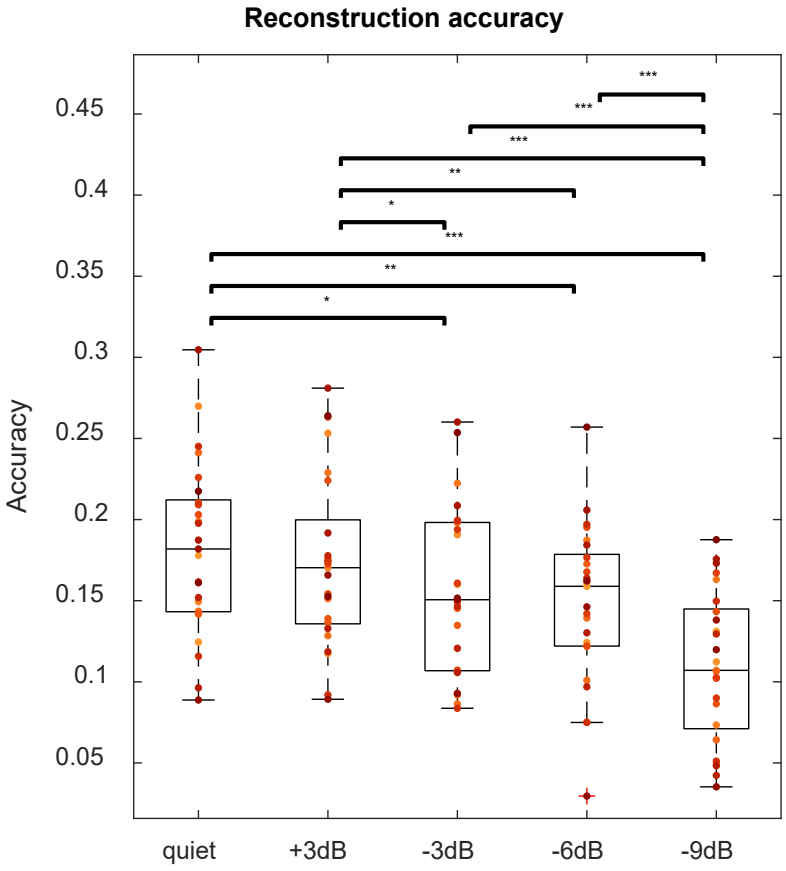
- Experiment
  - Speech in quiet
  - Speech in a little noise
  - Speech in more noise

Preliminary Results Aim 1

- 25 Neurotypical Adults (>18 years)



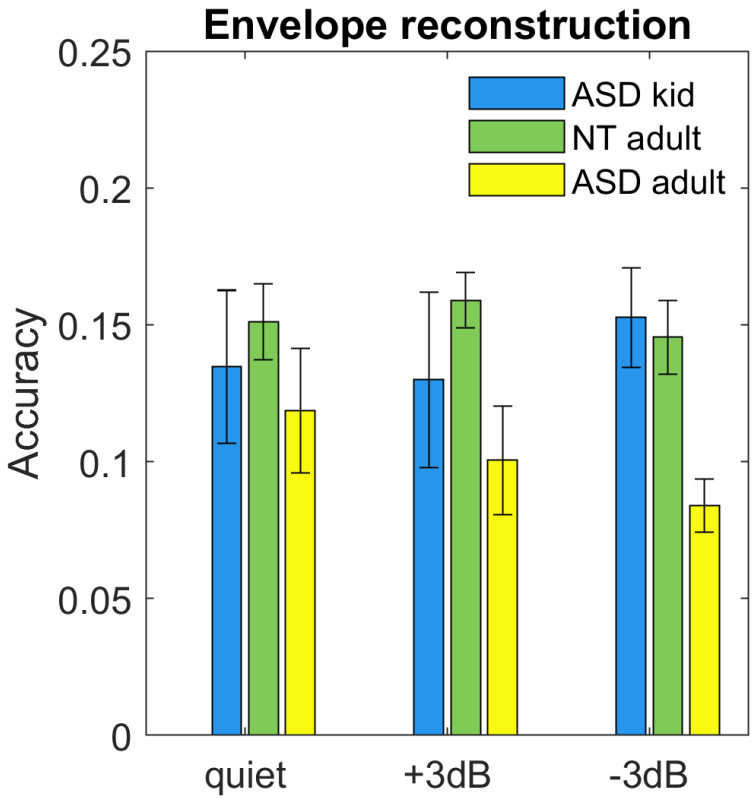
Preliminary Results Aim 1



Preliminary Results Aim 2

- 3 Neurotypical Adults (18-21 years)
- 3 Adults with ASD (18-21 years)
- 3 Adolescents with ASD (14-17 years)

Preliminary Results Aim 2



Summary

- Perception involves a “merger” of sensory information with our prior (predictive) knowledge of the world.
- Differences in this “predictive perception” may explain some of the symptoms of autism (and schizophrenia).
- Natural speech involves predictions!
- EEG brainwaves track the acoustics of speech.
- The predictability of words alters the acoustic processing of speech – reflecting the merger of predictions with sensory input.
- This measure varies across different noise levels in neurotypical adults.
- Data collection in adolescents and young adults with ASD is ongoing to test the hypothesis that people with ASD may rely less on predictions when processing sensory input.

Thanks

- Professor John Foxe
- Professor Andrew Anderson
- Professor Leona Oakes
- Ms. Shyanthony Synigal
- Ms. Xueying Wang
- Dr. Ole Bialas