# How the Brain Processes Speech in Noise: Solving the Cocktail Party Problem

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Isolating one voice (or other sound source), from a crowded auditory scene, is an incredible computational feat that is easy to take for granted. How the brain performs the underlying computations is not known.

Alex Katz, The Cocktail Party

## Current and Future Directions

Neural representations of the **background**?

- *independent objects vs. residual background*

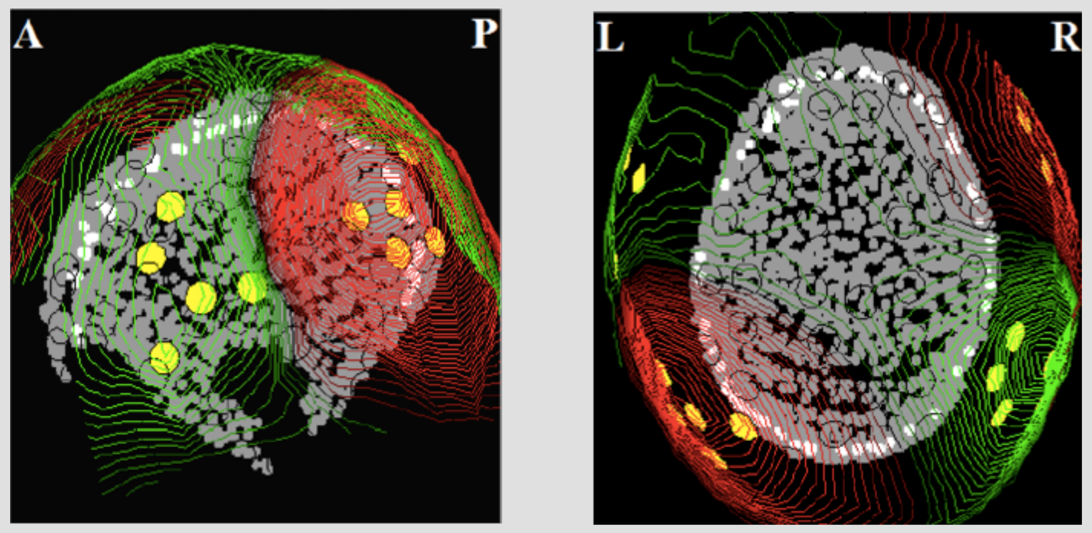
Aging Brains and the Cocktail Party Problem

- *the price of loss of neural temporal precision?*

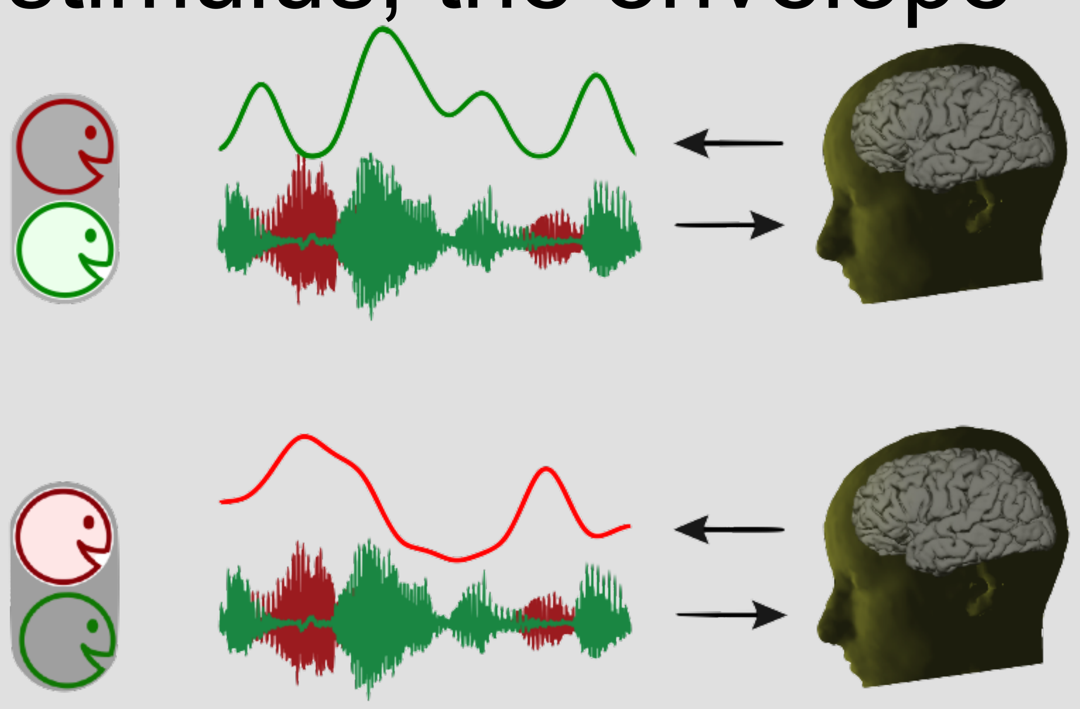
Schizophrenia and the Cocktail Party

- *dissociation between perception and sound*

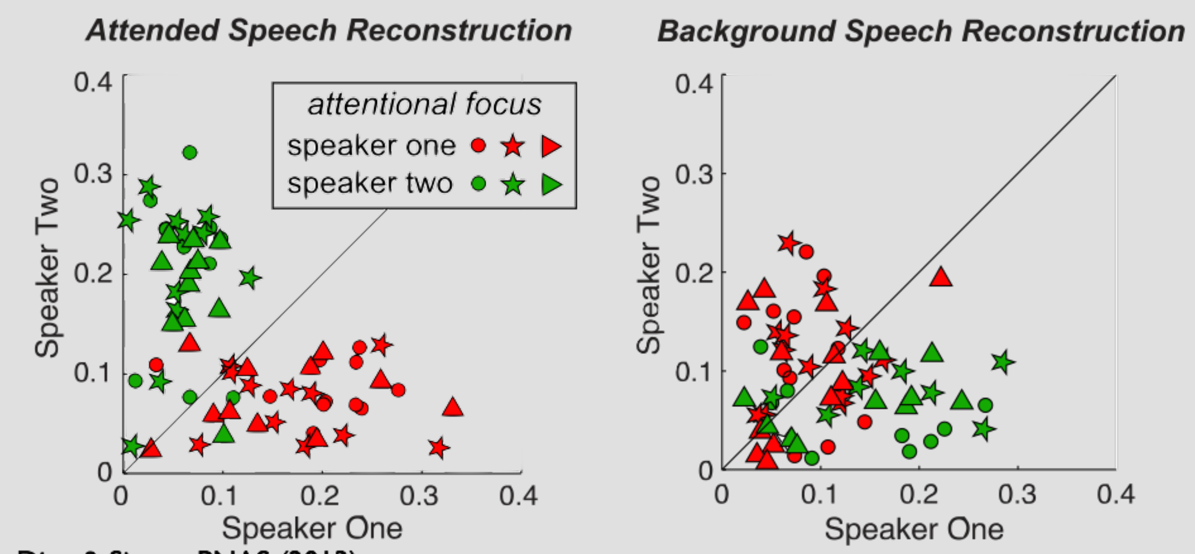
We use magnetoencephalography (MEG) to non-invasively record the neural activity of human subjects listening to speech in noisy but natural environments.




Using reverse correlation, between the neural activity and a speech stimulus, the envelope of an attended speech stream can be approximately reconstructed (~4 bits/s fidelity).



Which speech stream is being attended can be determined from the neural activity of the listener with >90% accuracy (measured non-invasively!).




Ding & Simon, PNAS (2013)

This result, that neural activity time-locks to attended speech, is extremely robust:

- ✓ varying loudnesses between speakers
- ✓ in loud stationary background noise
- ✓ in reverberant environments
- ✓ for spectrally degraded speech
- ✓ more…

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*Ding, N. and J. Z. Simon (2012) Proc Nat Acad Sci, 109(29), 11854-11859.*
*Ding, N. and J. Z. Simon (2013) J Neurosci 33(13), 5728-5735.*
*Ding, N., M. Chatterjee and J. Z. Simon (2014) NeuroImage 88 41–46.*

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