Foreground and Background at the Cocktail Party—Psychophysics & MEG

The Interaction Between Attention and Auditory Pop-out

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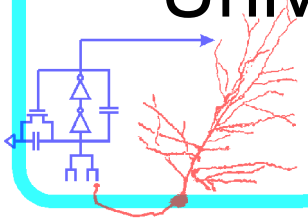
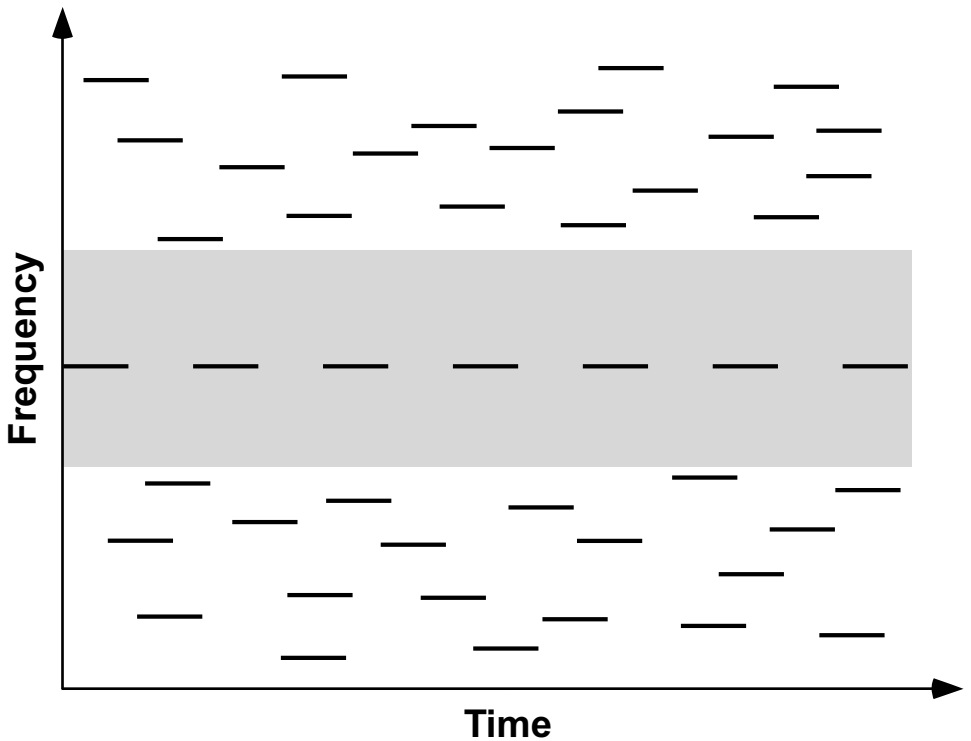
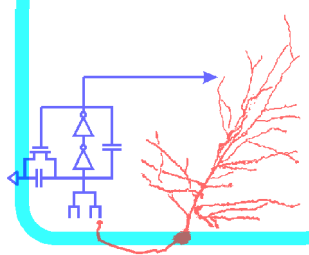
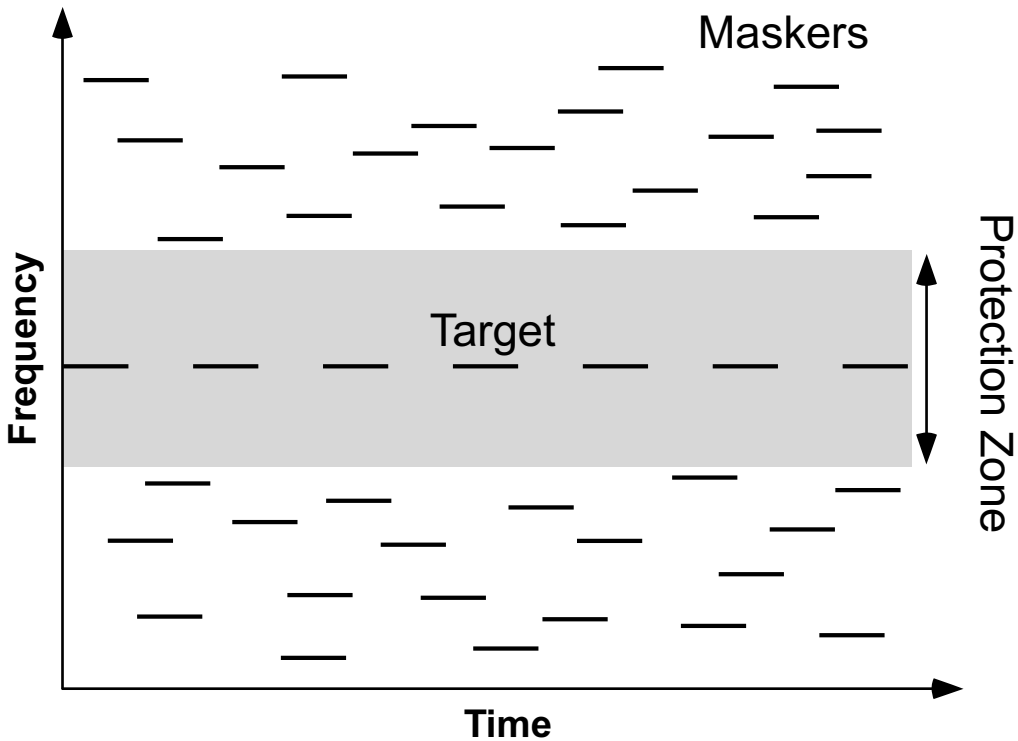


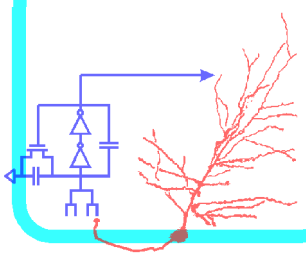
Introduction





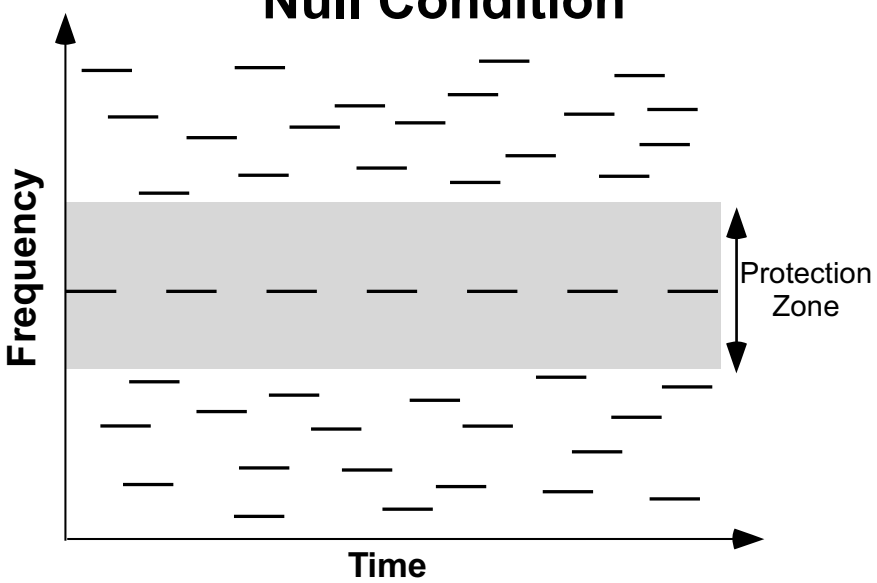
Introduction



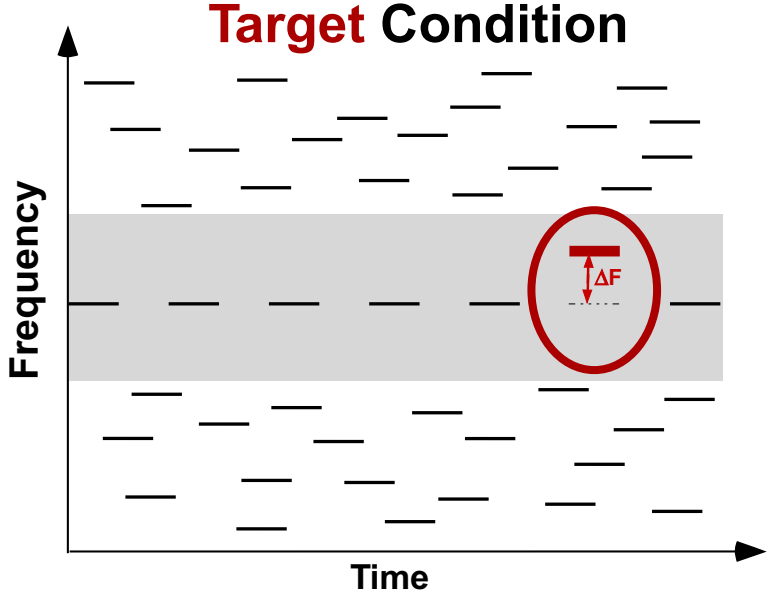


Experimental Paradigm

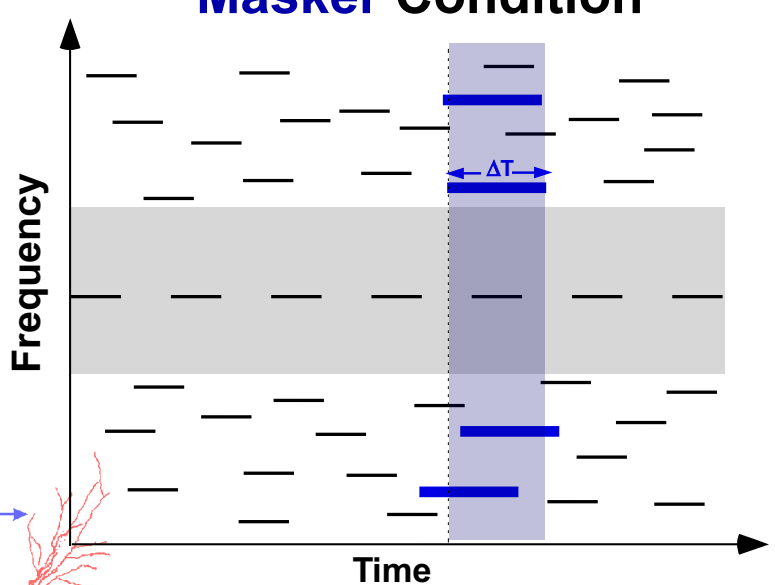
Null Condition



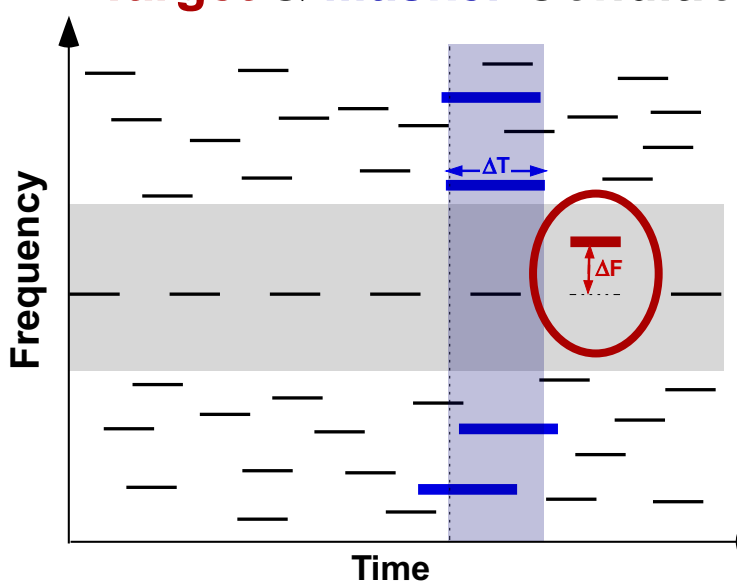
Target Condition



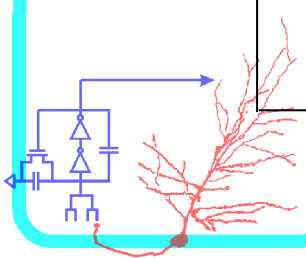
Masker Condition



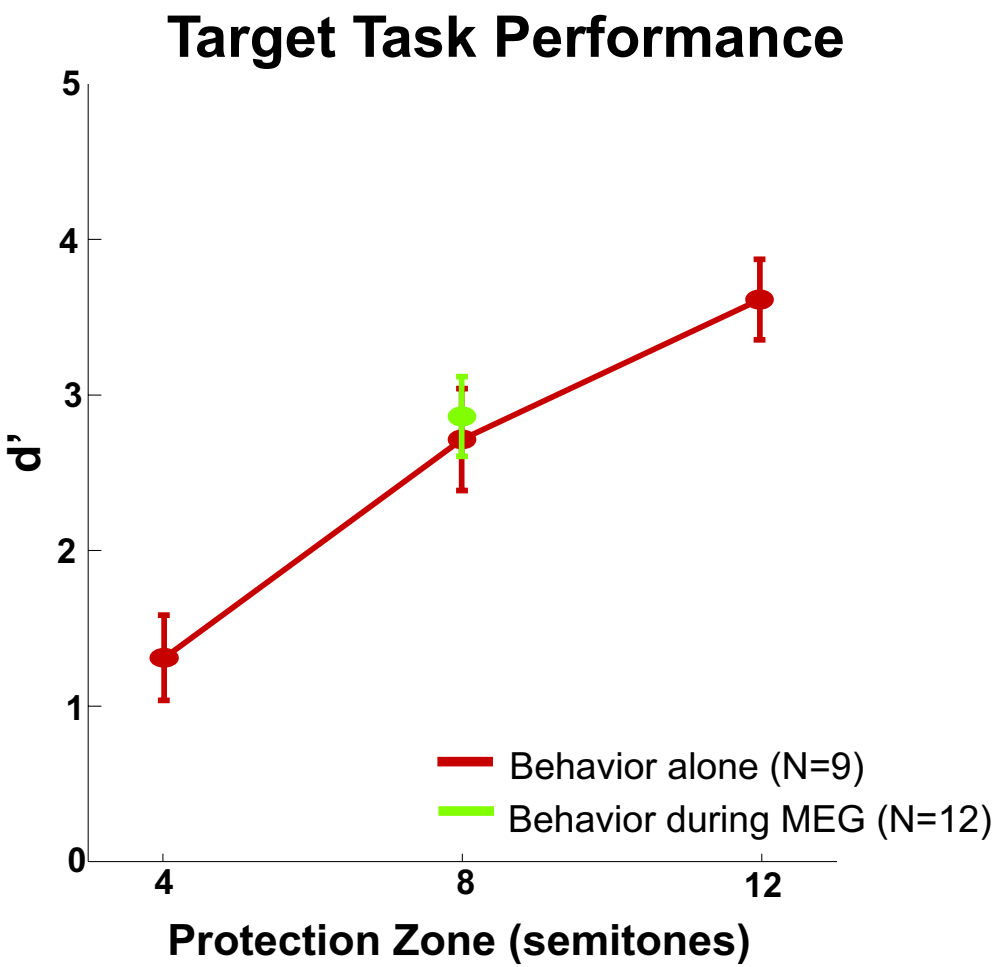
Target & Masker Condition

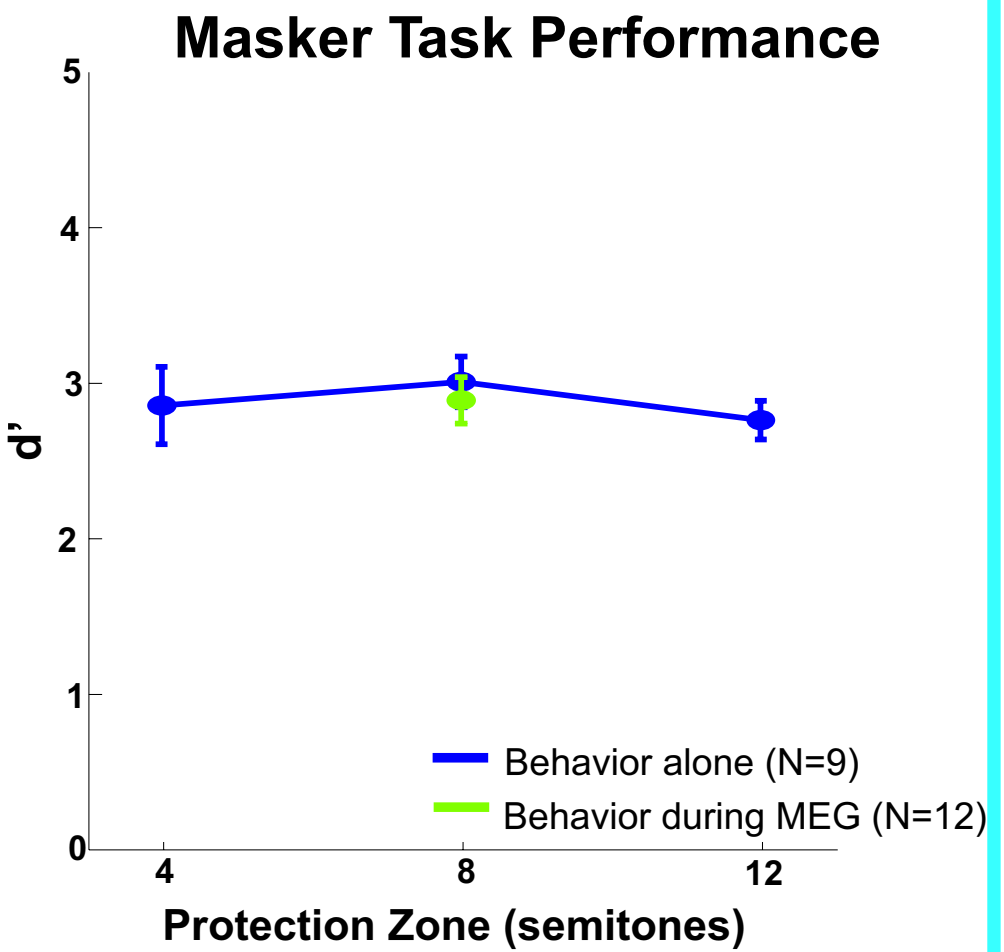


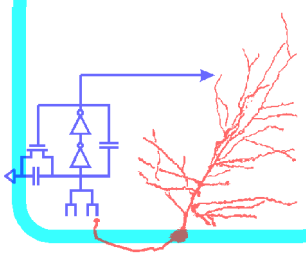
Target rate: 4Hz
Target rove:250-500 Hz
Duration: 5.5 s
Protection Zone:
4, 8, 12 st/ 8 st
Band: 5 Oct @ 353 Hz
Tone dur: 75 ms
Target dev: +/- 2 st
Masker dev: 400 ms



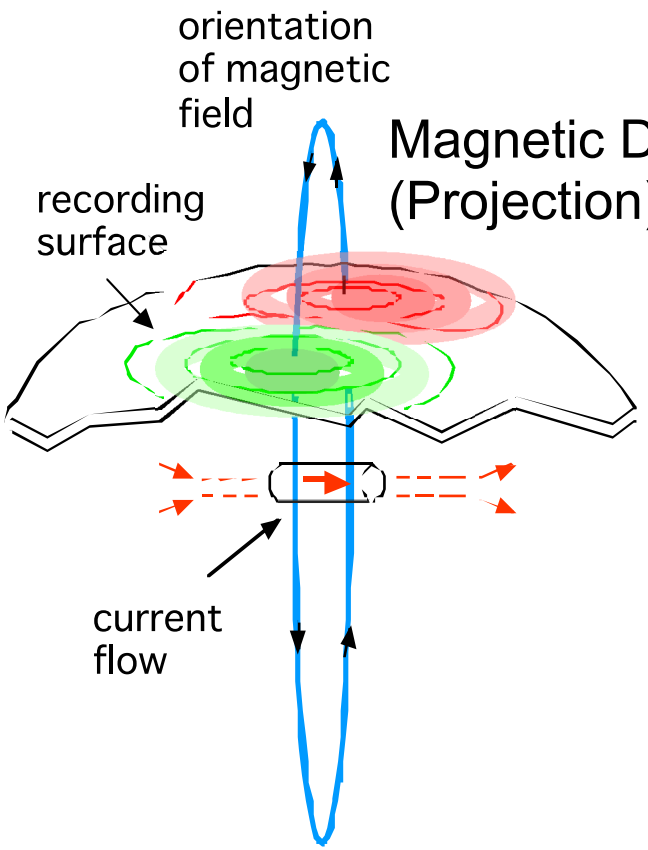
Behavior for Target and Masker Tasks





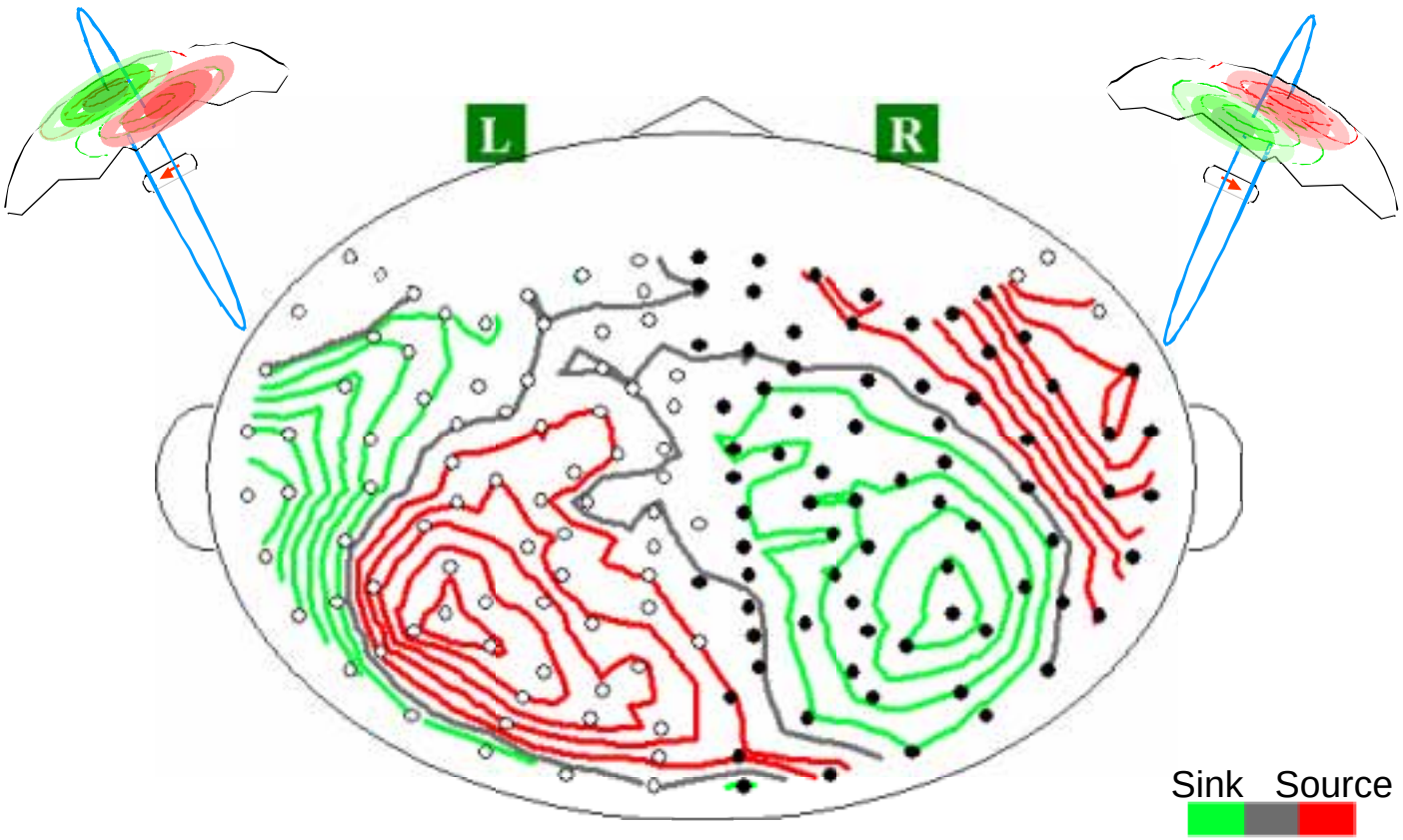


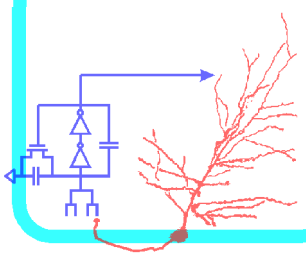
MEG Measures Neural Currents



Magnetic Dipolar Field
(Projection)

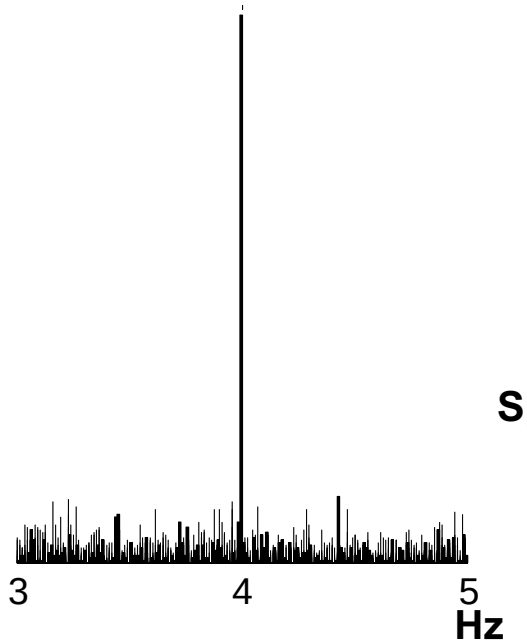
- MEG = Magnetoencephalography
- Direct electrophysiological measurement
  - not hemodynamic
  - real-time
- No unique solution for distributed source



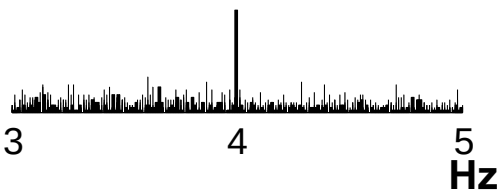


Neural Response to Target

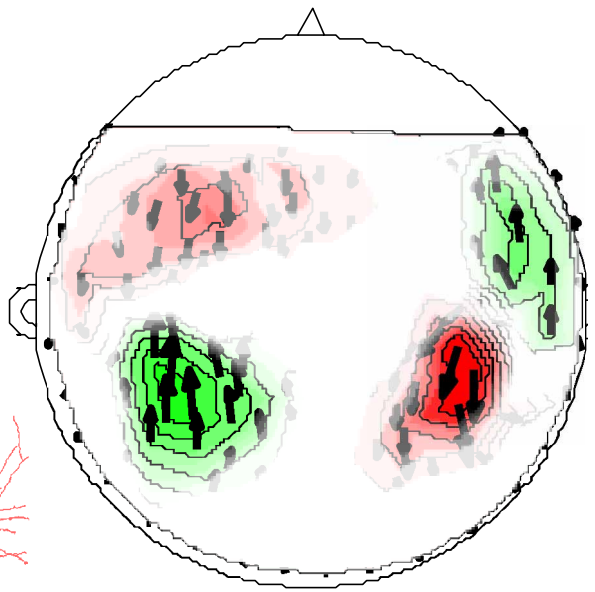
Neural Response to Target
Target Task



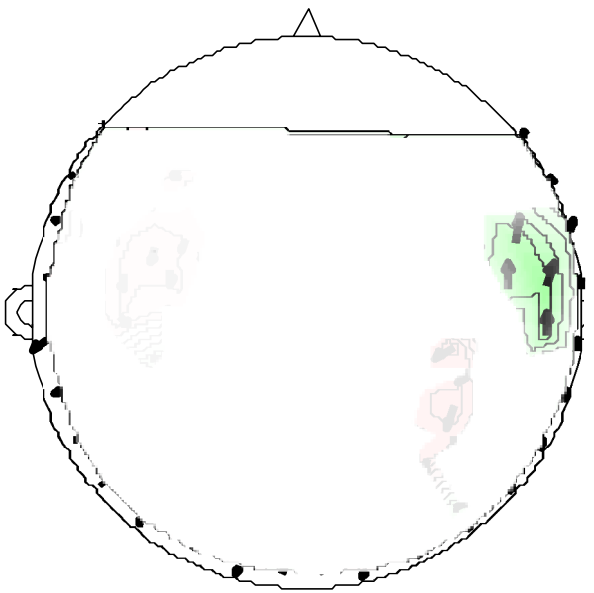
Neural Response to Target
Masker Task

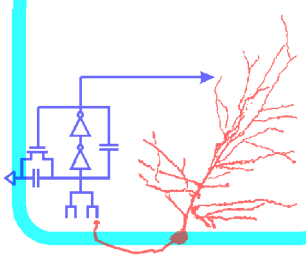


Spectral Power Density
(best channel)

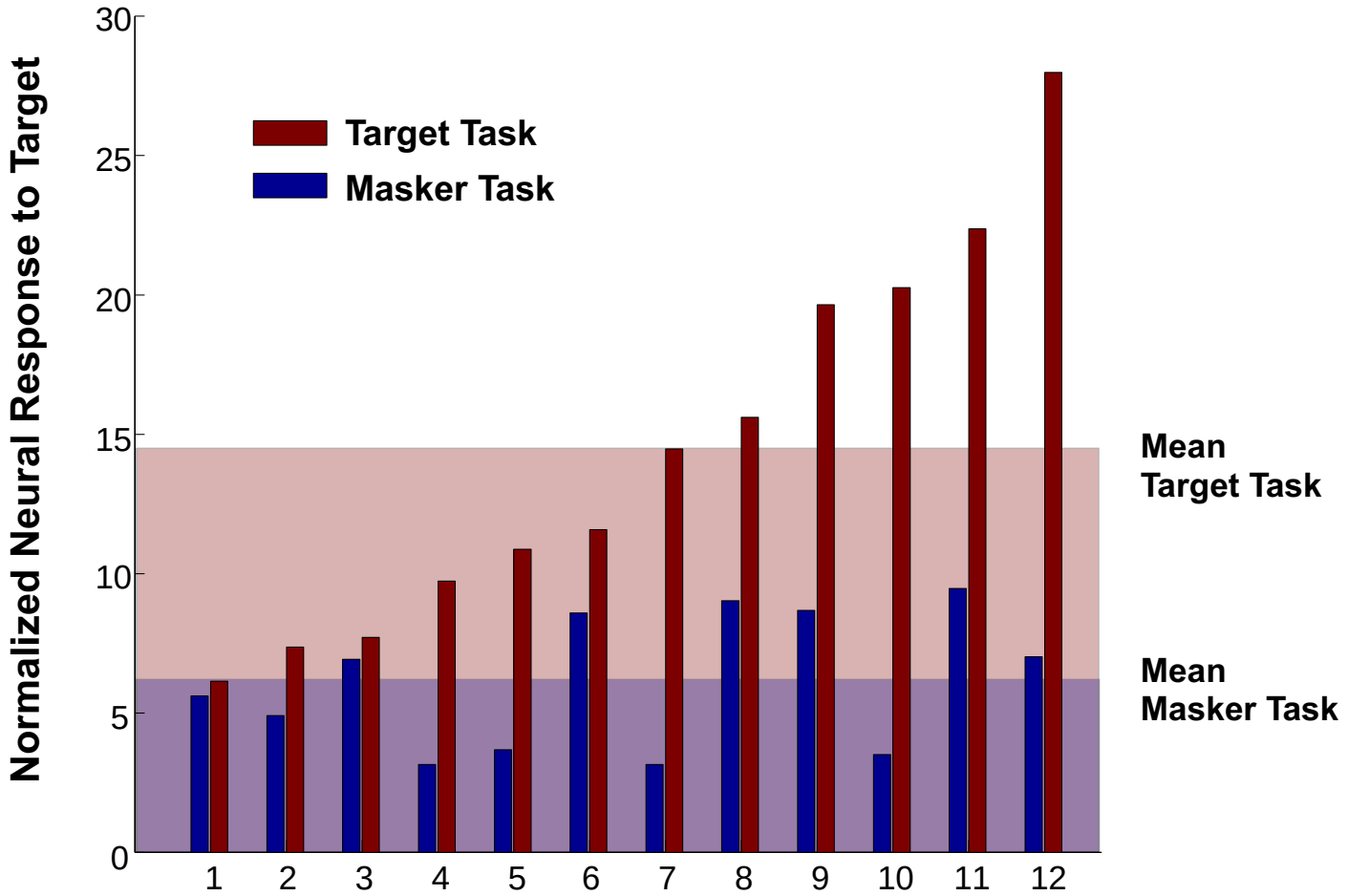


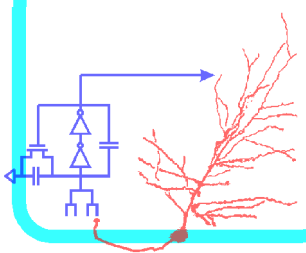
Whole Head
Neural Response
to Target





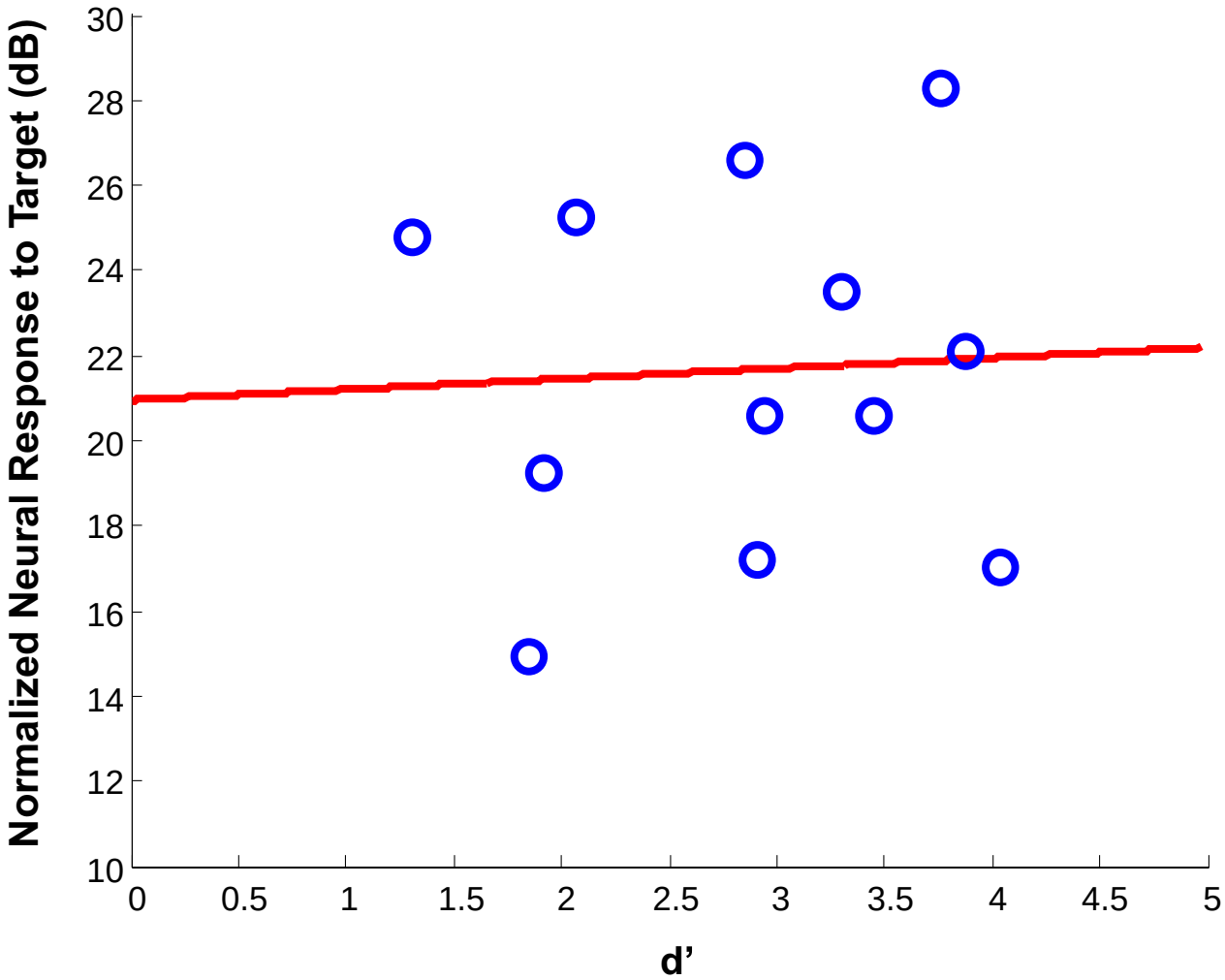
Neural Response to Target by Task





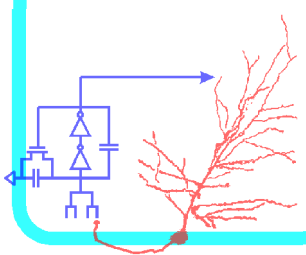
Neural Response to Target vs. Behavior

Neural (Target)



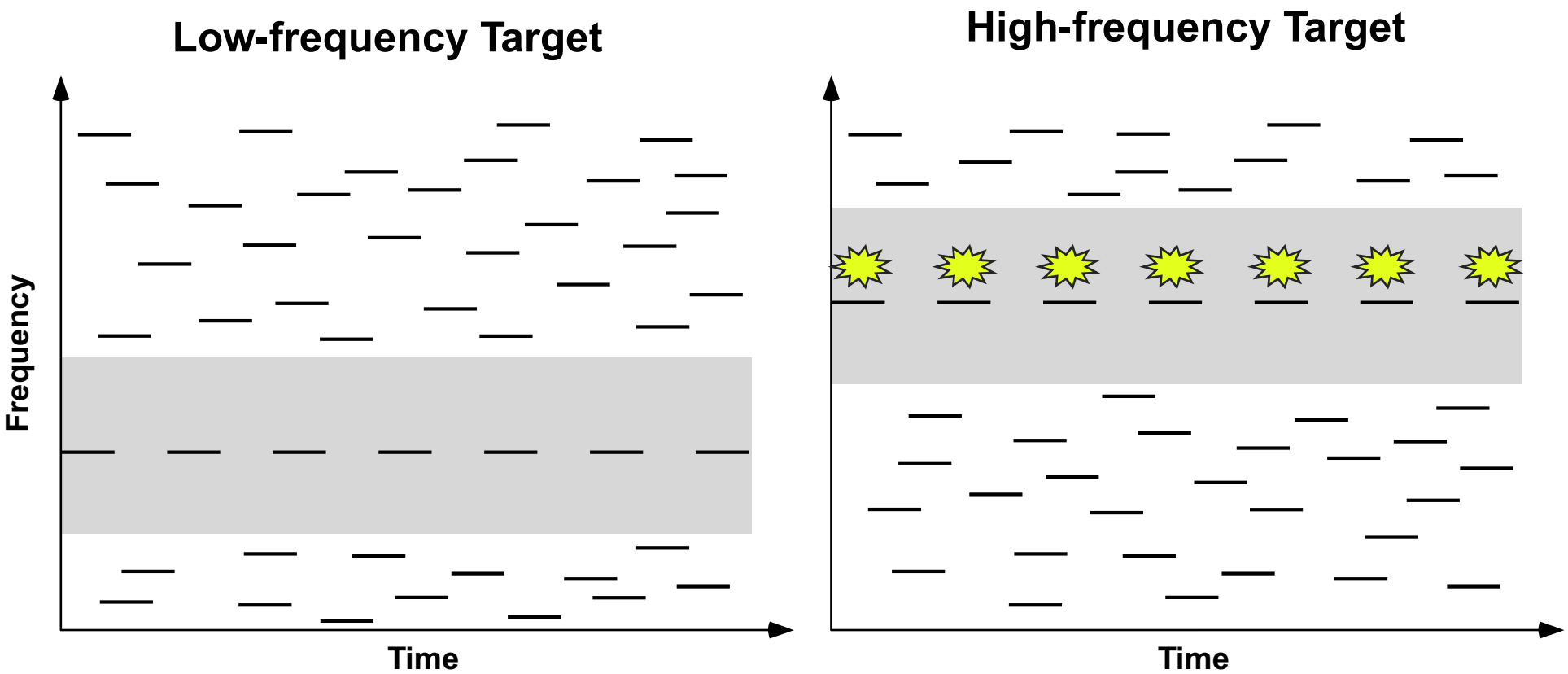
Behavior (Target)

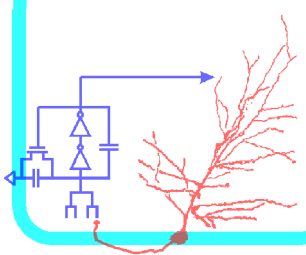
Target Task



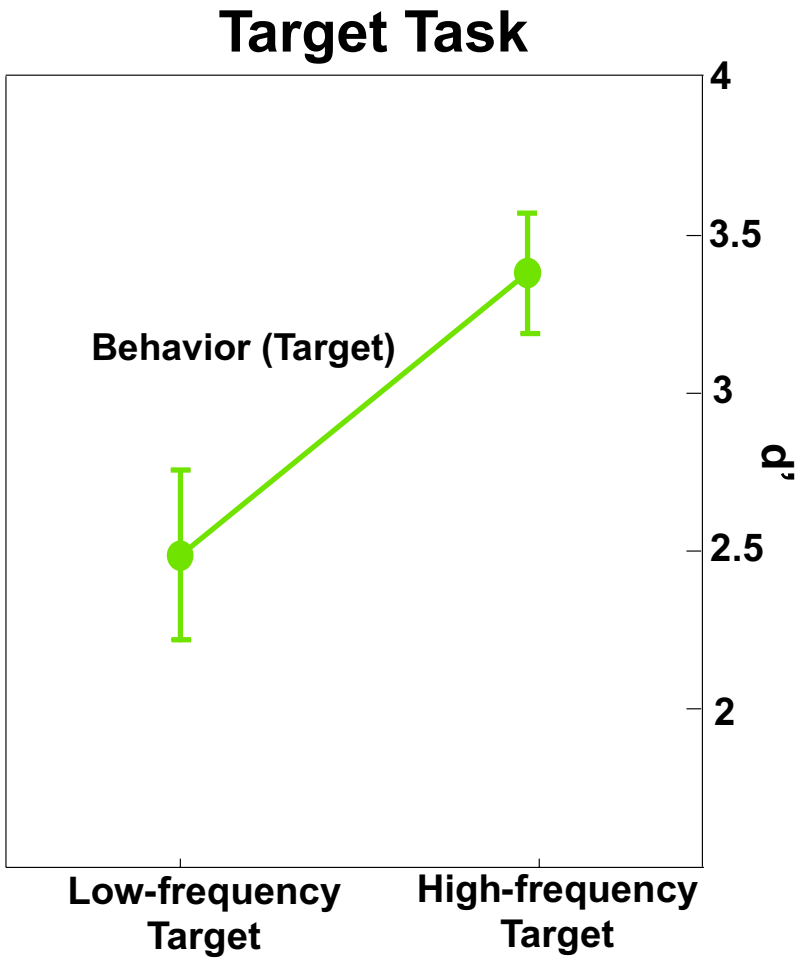
Effect of Target Frequency

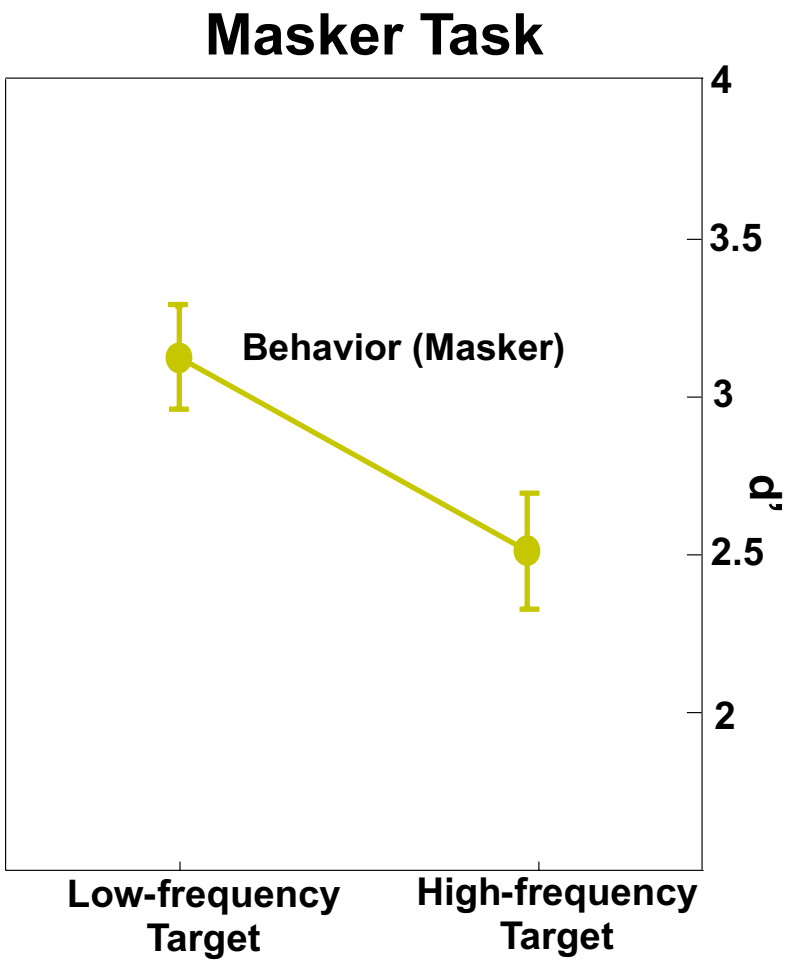
Auditory Pop-out





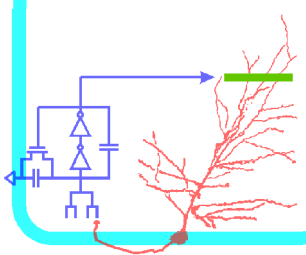
Effect of Target Frequency
Auditory Pop-out





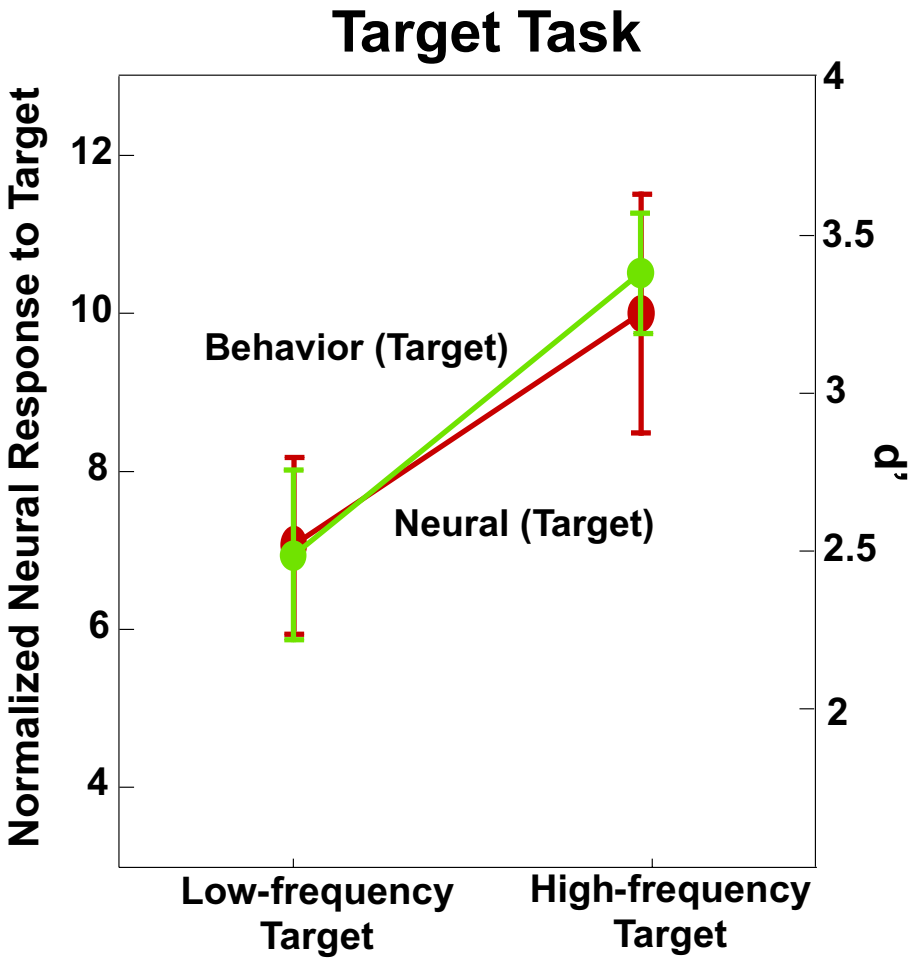
Behavior from MEG (N=12)

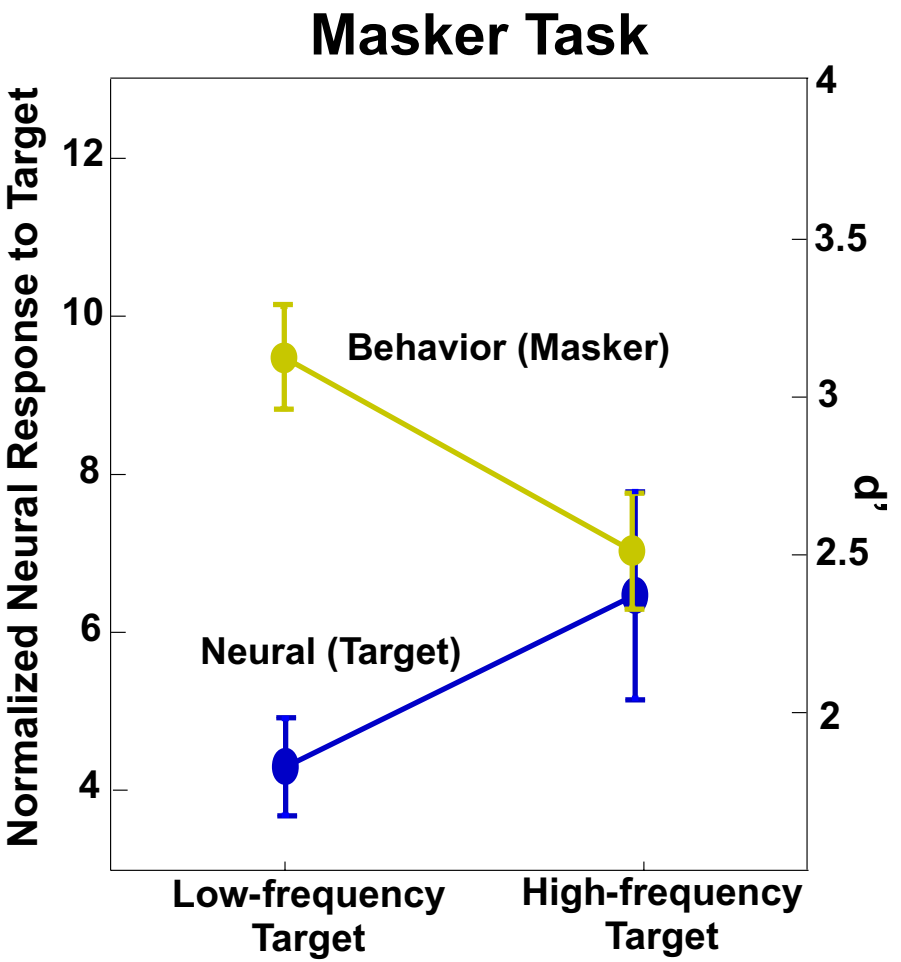
Behavior from MEG (N=12)



Effect of Target Frequency

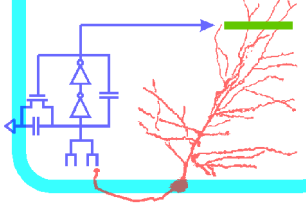
Auditory Pop-out



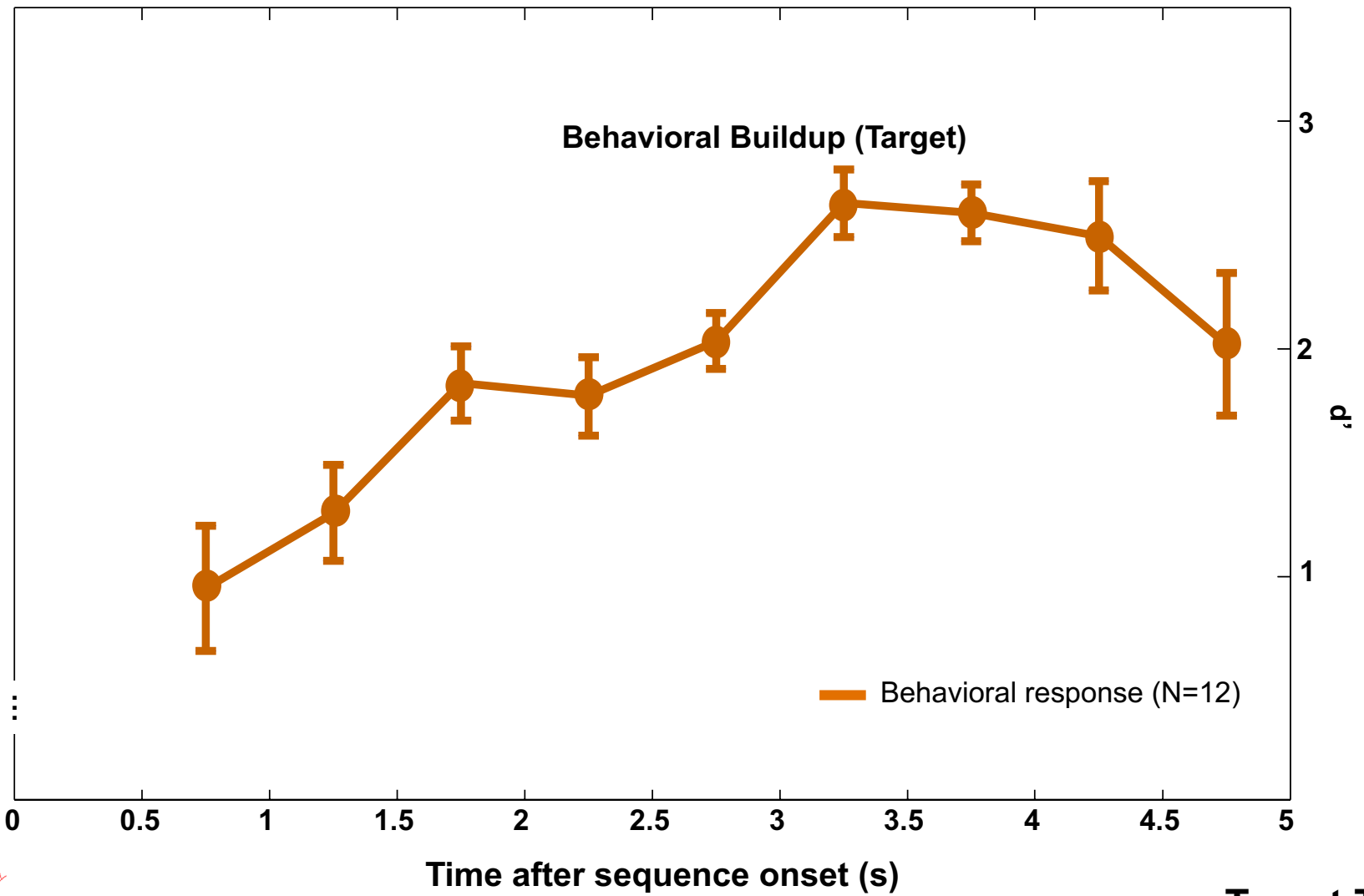


Neural response (N=12)
Behavior from MEG (N=12)

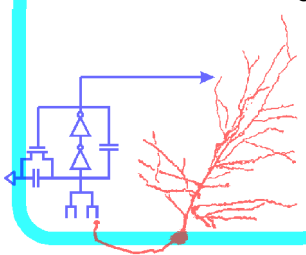
Neural response (N=12)
Behavior from MEG (N=12)



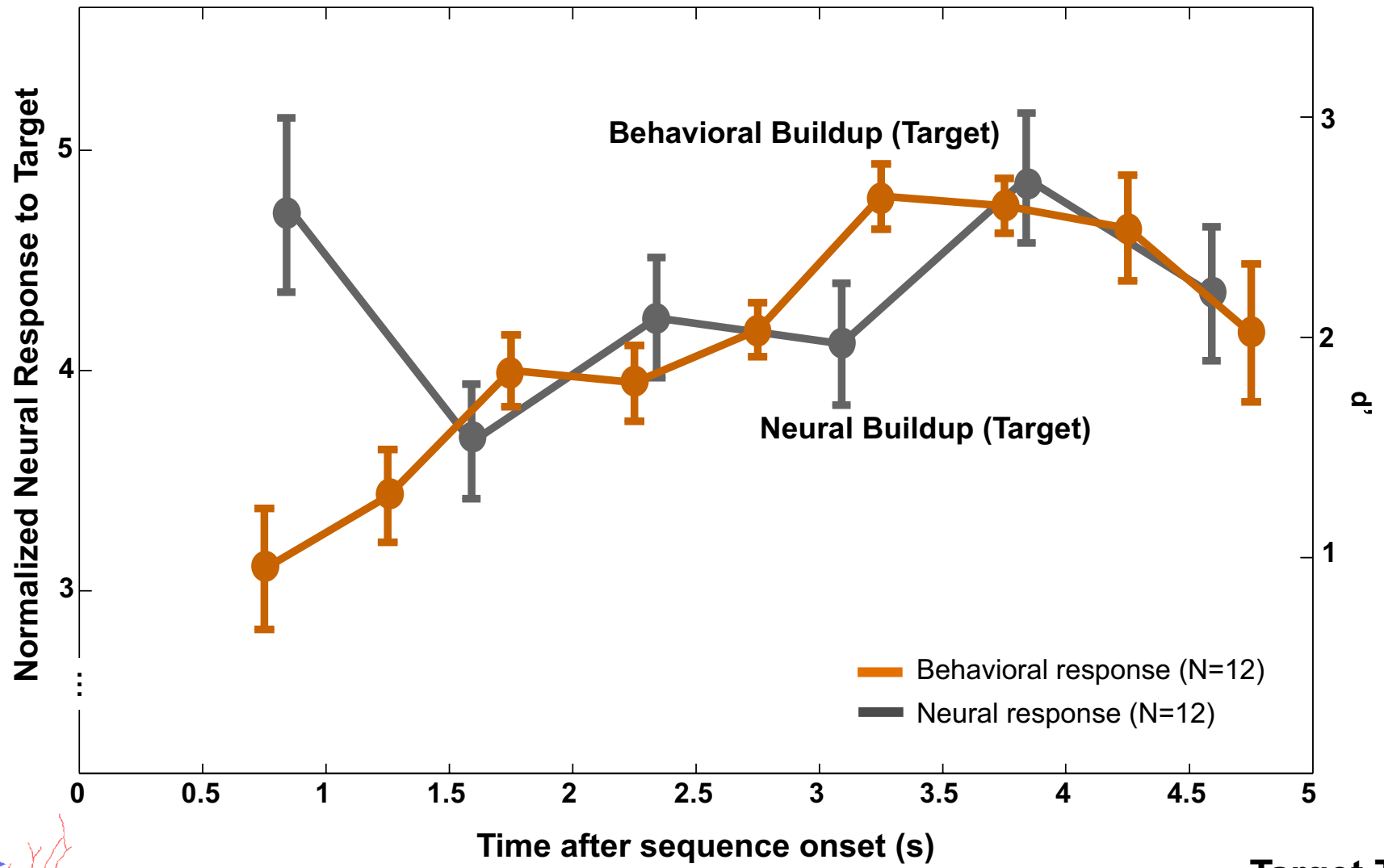
Behavioral & Neural Build-ups



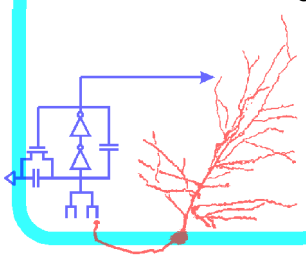
Target Task



Behavioral & Neural Build-ups

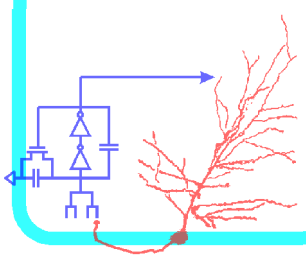


Target Task



Summary

- Strong Neural Response to Target
- Attention strongly modulates Neural Response
- Behavior correlates with Neural Response
- Auditory Pop-out
  - Target Pop-out correlates with Neural Response
  - Target Pop-out interferes with Masker Task
- Similar buildup for Behavior & Neural Response



Thanks to

David Poeppel
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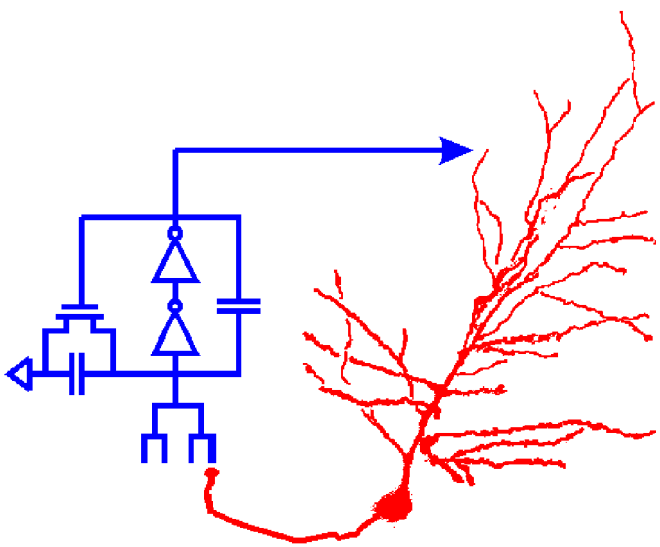
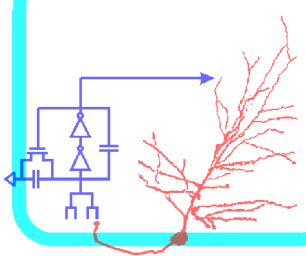
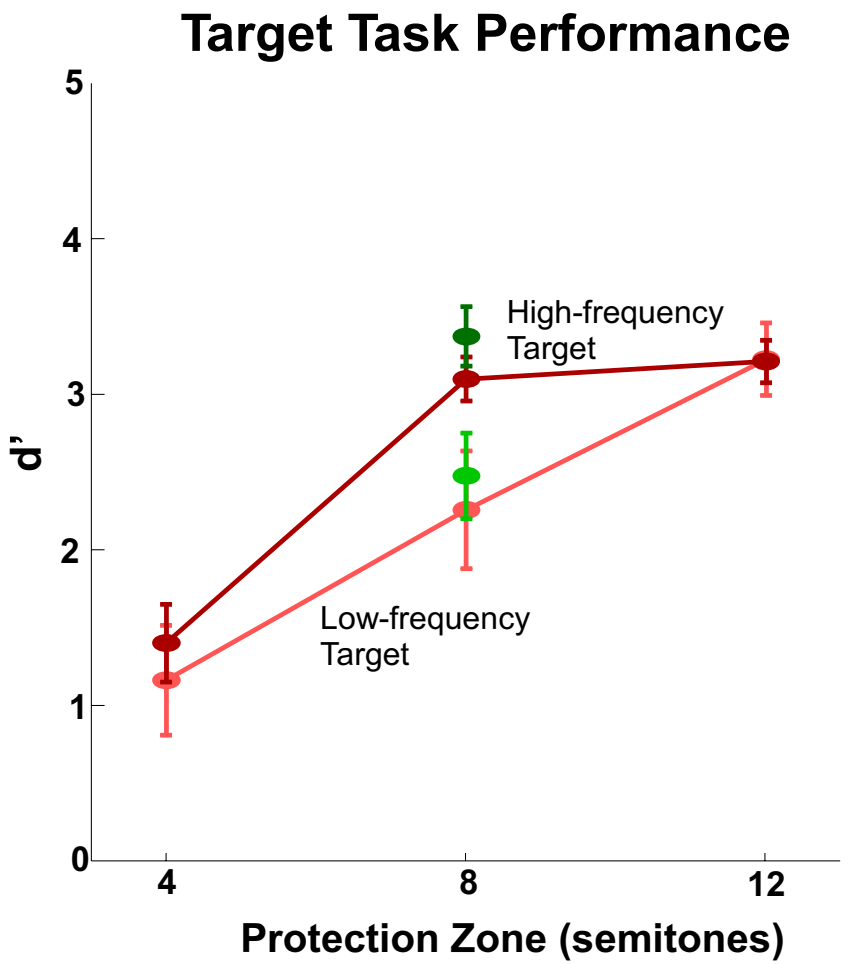
Supported by

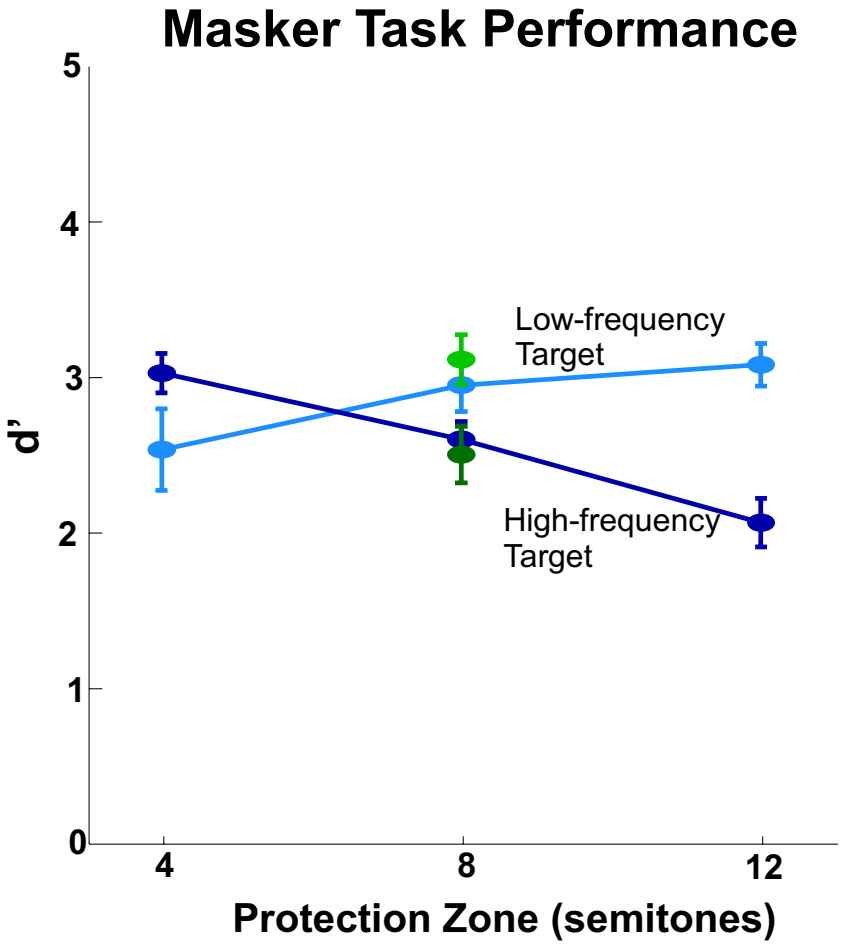
NIDCD & NIA

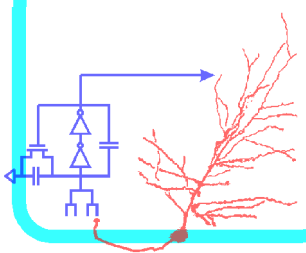




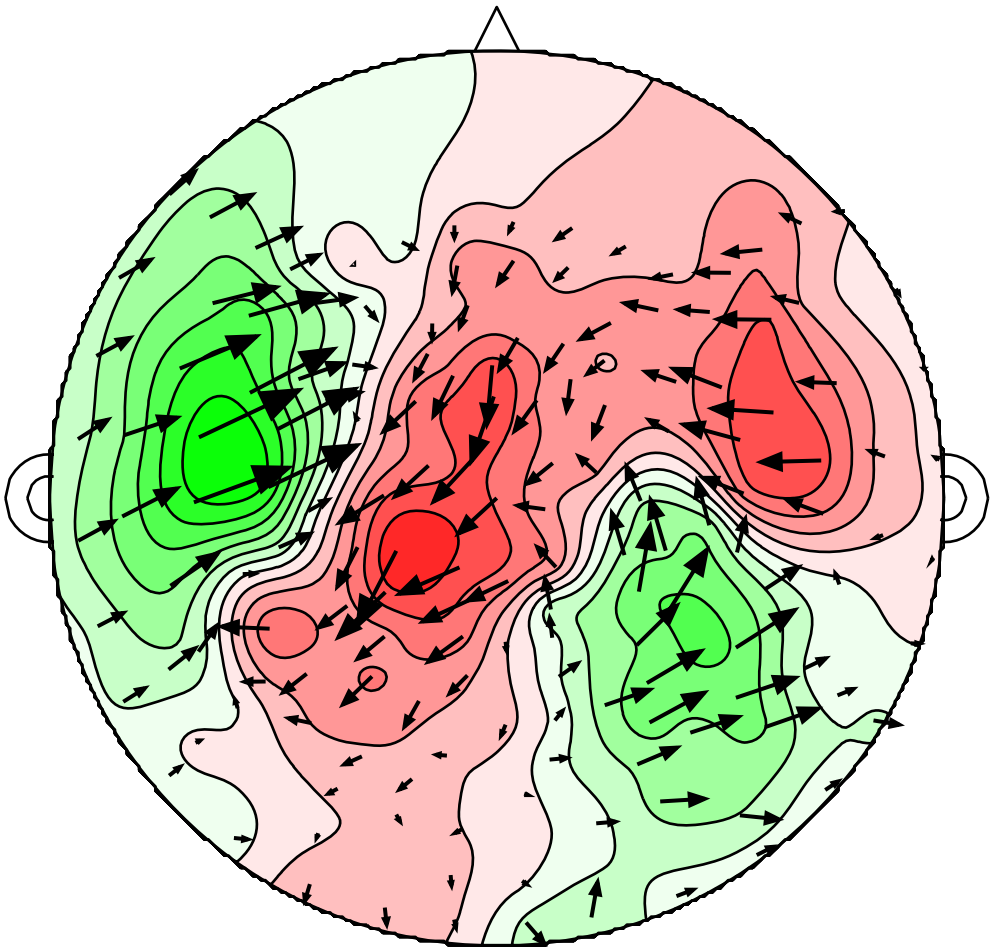
Effect of Target Frequency
Auditory Pop-out

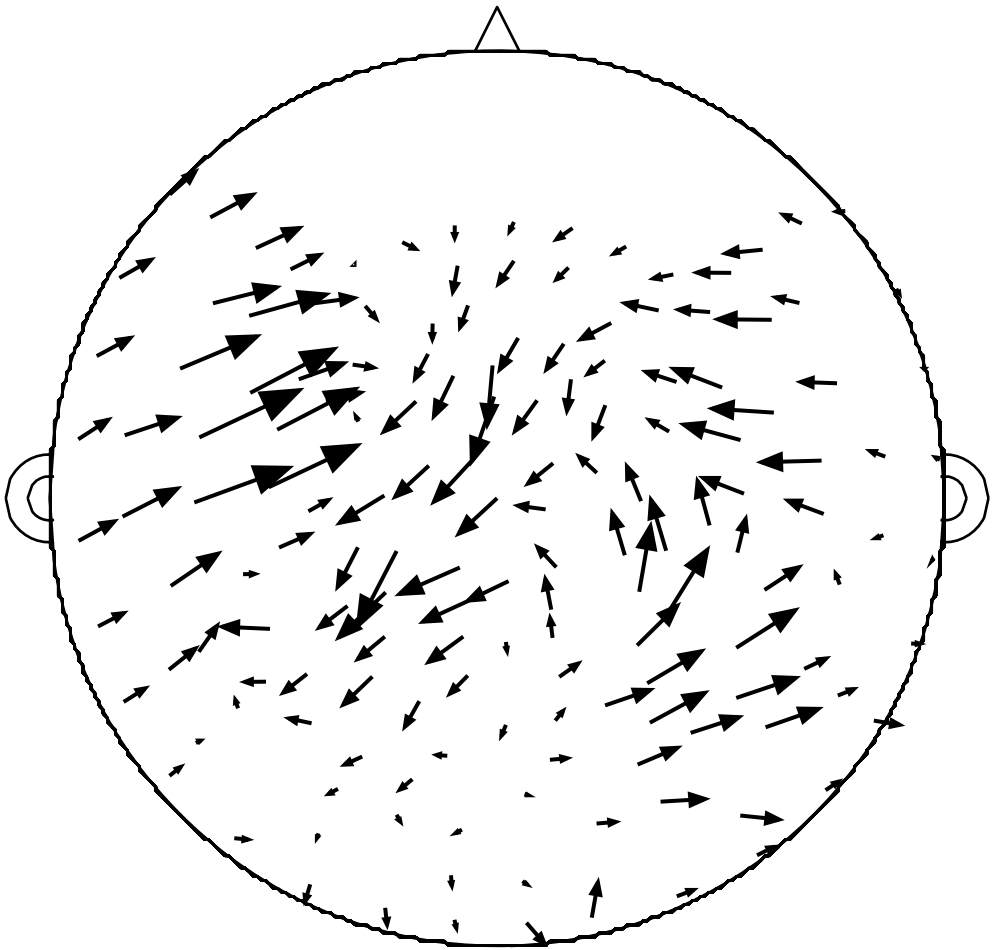


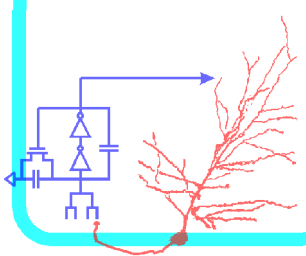




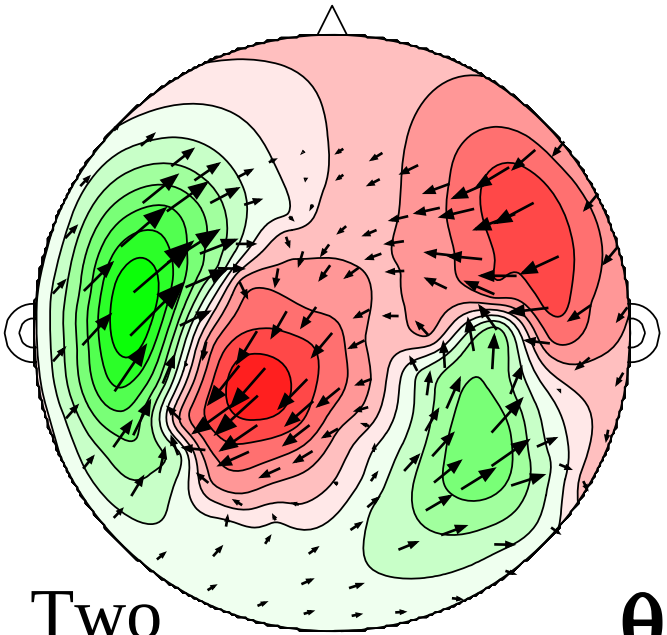
Complex Magnetic Field







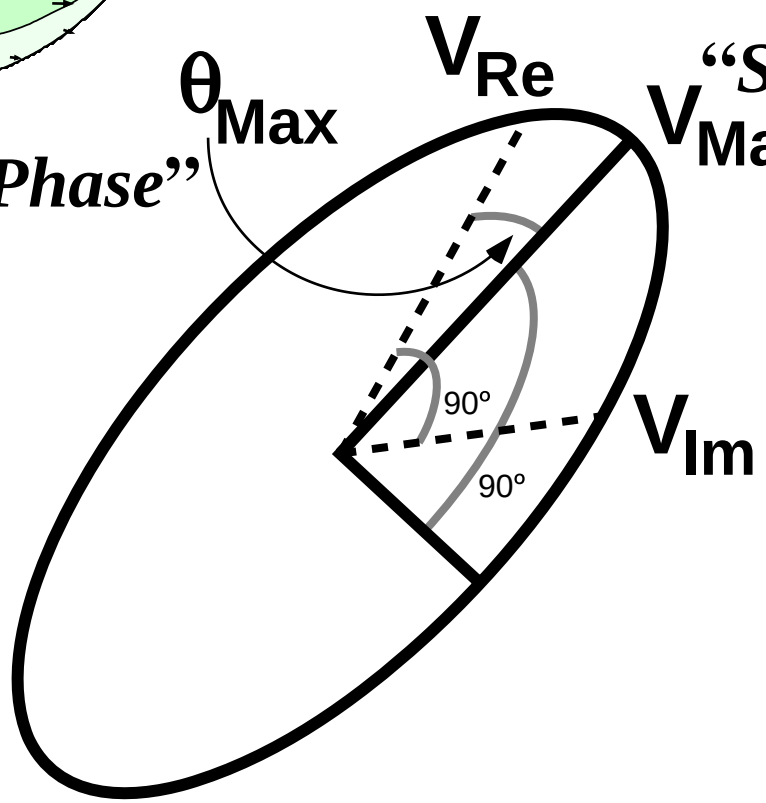
Complex Equivalent-Current Dipoles



Two Dipole Fit

$$\vec{V} = \vec{V}_{Re} + i\,\vec{V}_{Im}$$

$$\vec{V}(\theta) = \vec{V}_{Re}\cos(\theta) + \vec{V}_{Im}\sin(\theta)$$



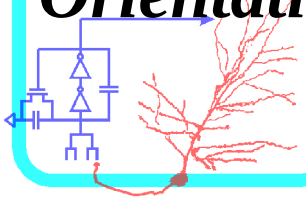
$\hat{V}_{Max}, \hat{V}_{Min}$ *Orientations*

"*Sharpness*"

$$\eta = \frac{|V_{Min}|}{|V_{Max}|}$$

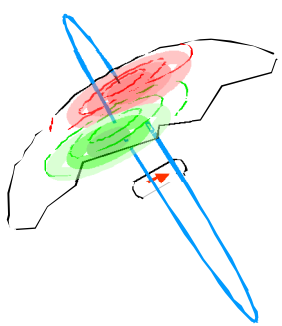
$$0 < \eta < 1$$

Physiologically Simple Current Sources: $\eta = 0$

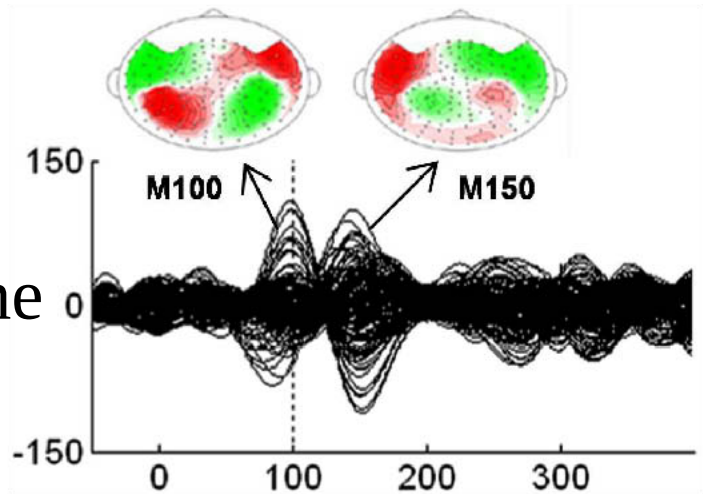


Time Course of MEG Responses

Evoked Responses
MEG Events Time-Locked
to Stimulus Event



Pure Tone



Broadband Noise