Foreground and Background at the Cocktail Party—Psychophysics & MEG
The Interaction Between Attention and Auditory Pop–out

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Introduction
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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

Target Task Performance

Masker Task Performance

Protection Zone (semitones)

Behavior alone (N=9)
Behavior during MEG (N=12)
MEG Measures Neural Currents

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

Magnetic Dipolar Field (Projection)

orientation of magnetic field

recording surface

current flow

SourceSink

40 ft/Step

Computational Sensorimotor Systems Laboratory
Neural Response to Target vs. Behavior

![Graph showing the relationship between Neural Response to Target and Behavior (Target)](image)
Effect of Target Frequency
Auditory Pop-out

Low-frequency Target

High-frequency Target
Effect of Target Frequency
Auditory Pop-out

Target Task

- Low-frequency Target
- High-frequency Target

Behavior (Target)

Masker Task

- Low-frequency Target
- High-frequency Target

Behavior (Masker)

Behavior from MEG (N=12)
Effect of Target Frequency
Auditory Pop-out

**Target Task**

- **Behavior (Target)**
- **Neural (Target)**

**Masker Task**

- **Behavior (Masker)**
- **Neural (Target)**

- **Normalized Neural Response to Target**

- **Low-frequency Target**
- **High-frequency Target**

- **Normalized Neural Response to Target**

- **Low-frequency Target**
- **High-frequency Target**

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

- **Behavior from MEG (N=12)**
Behavioral & Neural Build-ups

![Graph showing normalized neural response to target over time after sequence onset](image)

- **Behavioral Buildup (Target)**
- **Neural Buildup (Target)**

- **Orange line**: Behavioral response (N=12)
- **Gray line**: Neural response (N=12)

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
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Effect of Target Frequency Auditory Pop-out

Target Task Performance

Masker Task Performance
Complex Magnetic Field
Complex Equivalent–Current Dipoles

\[ \vec{V} = \vec{V}_{Re} + i \vec{V}_{Im} \]

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

Two Dipole Fit

\text{"Phase"} \rightarrow \theta_{Max}

\text{\textbf{\textquotedblright}Strength\textbf{\textquotedblright}} \rightarrow \vec{V}_{Max}

\text{\textbf{\textquotedblright}Sharpness\textbf{\textquotedblright}} \rightarrow \eta = \frac{|V_{Min}|}{|V_{Max}|}

0 < \eta < 1

Physiologically Simple Current Sources: \( \eta = 0 \)

\text{\textbf{\textquotedblright}Orientations\textbf{\textquotedblright}}

\( \hat{V}_{Max}, \hat{V}_{Min} \)
Time Course of MEG Responses

Evoked Responses
MEG Events Time-Locked to Stimulus Event

Pure Tone

Broadband Noise