

Princeton **Neuroscience** Institute

ABSTRACT

Previous studies have shown that it is possible to attend to a visual stimulus without being aware of the visual stimulus. However, it is not known whether this dissociation extends to other sensory modalities.

We developed a paradigm for testing auditory spatial stimuli at different levels of awareness. The spatial location of auditory stimuli was simulated using interaural time differences and interaural level differences. Awareness for those stimuli was controlled by masking them with bandpass filtered white noise. Spatial attention was measured using an auditory variant of the Posner attention paradigm.

METHOD

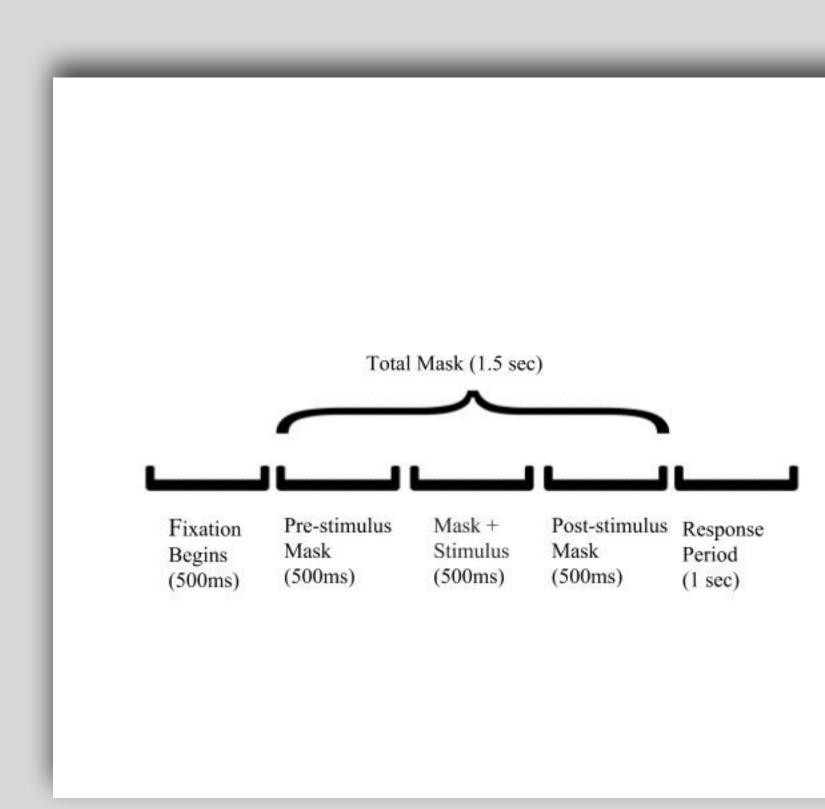
Method: Participants performed a task in which they attempted to detect a 700Hz sinusoidal tone. This tone was masked using white noise bandpass filtered between 600 Hz and 800 Hz. Participants began each trial by fixating on a centrally presented dot for 500 milliseconds (ms), and continued to fixate on this dot throughout the trial. This was followed by the bandpass filtered mask alone for 500 ms. This was followed by the tone and mask combined for 500 ms. This was followed by the mask alone again for 500 ms. Finally, participants had 1 second to make a response.

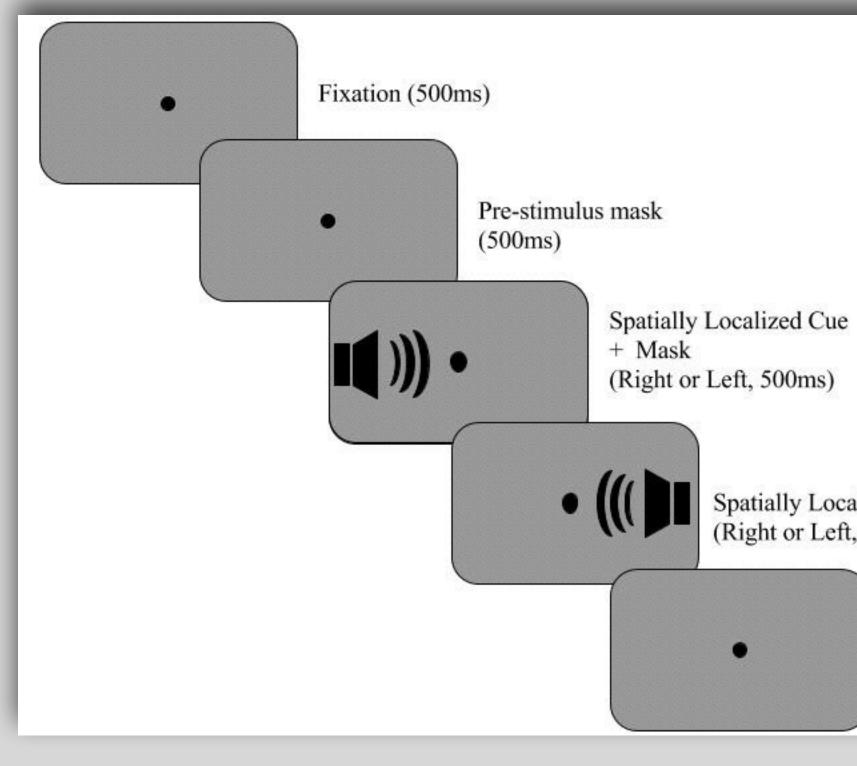
Participants pressed the F key if they detected a tone, and the J key if they did not detect a tone. Tones were spatially localized either to the right or the left, using a combination of interaural time differences and interaural level differences. Participants were presented with a leftlocalized tone on 1/3 of trials, a right localized tone on 1/3 of trials, and no tone on 1/3 of trials. The trials with no tone served as catch trials to ensure that participants were not guessing about the presence of the tone. Additionally, tones were presented at three different amplitudes: 2%, 3.5% and 5% signal-to-noise ratios.

Effects of Awareness on the Control of Attention: An Auditory Behavioral Paradigm

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RESULT





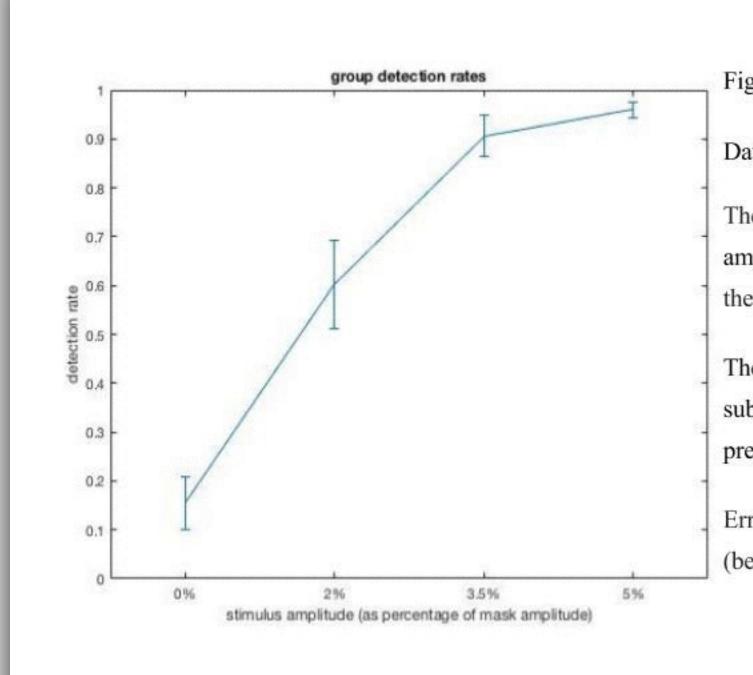


Figure 1 Masking Task:

Participants fixated on a centrally presented dot for the entirety of the trial. After fixation was presented for 500 ms, a pre-stimulus noise mask was played for 500 ms, followed by a mask and a single tone (700 Hz) for another 500 ms. A post-stimulus mask was then played for 500 ms. The trial ended with a 1 second response period.

Figure 2 Spatial Attention Task:

Participants will begin each trial with central fixation. After 500 ms of fixation, a pre-stimulus mask will be played for 500 ms. This will be followed by a combined mask and spatially localized cue (left or right) for 500 ms. Then a spatially localized target stimulus (left or right) will be played 500 ms. The trial will end with a response period for 1 second.

Spatially Localized Target (Right or Left, 500ms)

Response Period (1 sec)

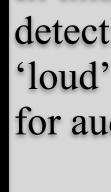
Figure 3 Result:

Data for 12 subjects.

The x-axis indicates the signal-to-noise ratio: stimulus amplitude / mask amplitude. '0%' indicates trials where the stimulus was not presented (mask only).

The y-axis indicates the detection rate: number of times subject detected / total number of times stimulus presented.

Error bars represent standard error of the mean (between-subject).



One important question is whether the masked stimuli in

this experiment will affect attention. In future tasks, we plan to use these stimuli as cues in an auditory version of the Posner attention paradigm. Previous work has explored differences between attention with and without awareness (Webb, Kean, & Graziano, 2016), but this work has been in the visual domain. An important step will be to determine whether these differences generalize to the auditory domain. The present experiment is a first step toward testing this question.

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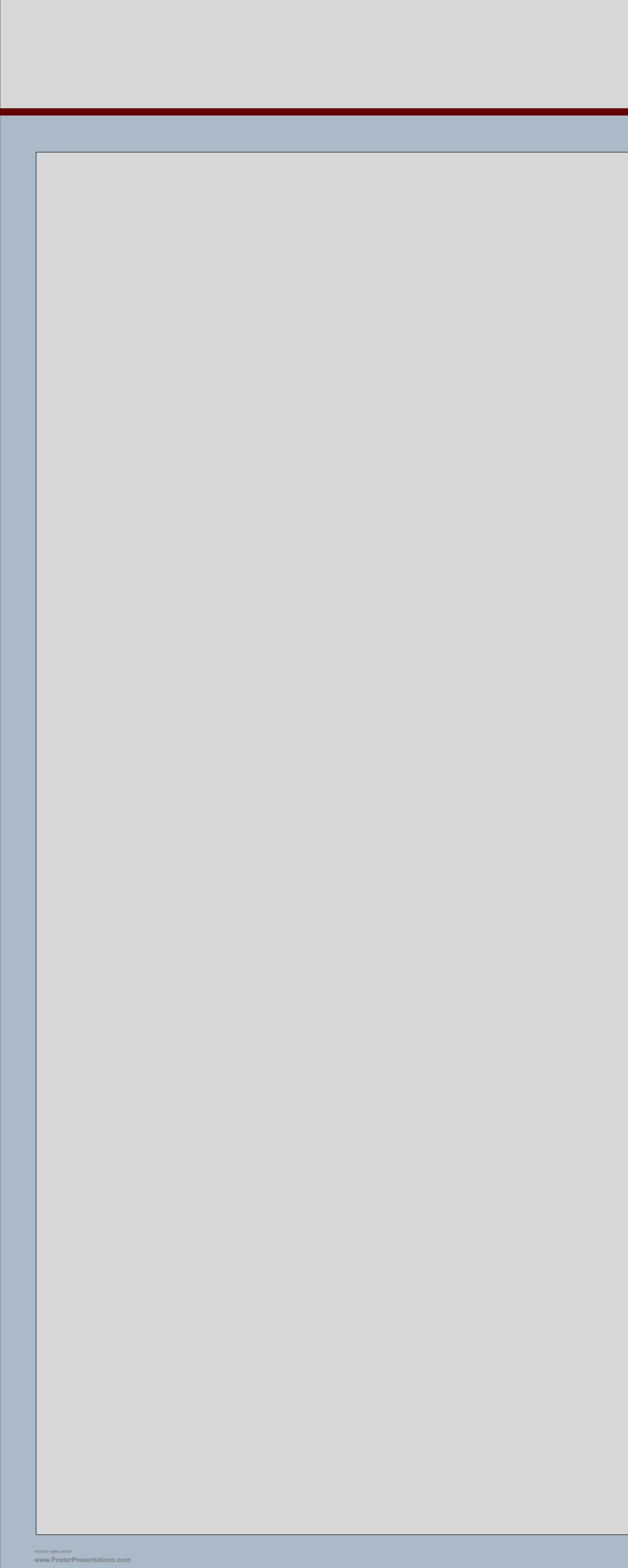
DISCUSSION

In this experiment, the 'quiet' trials resulted in 58% detection rate, 91% on the 'medium' trials and 96% on the 'loud' trials. The results established this as a viable method for auditory masking of spatially localized tones.

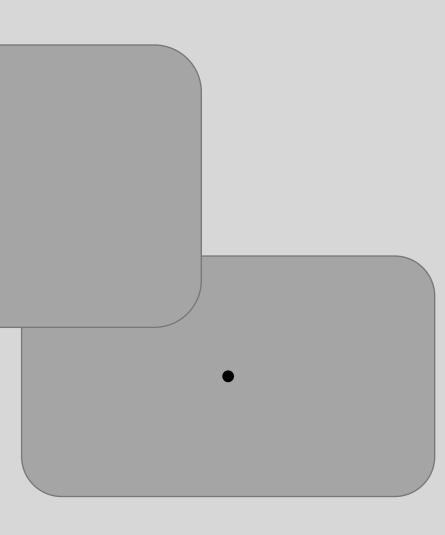
Questions for further research:

REFERENCE

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Spatially localized cue

