Ipsilateral Masking Effects on Hearing Thresholds in Adults

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Objectives

The purpose of this research study was to aid audiologists in developing a clinical test for patients with hearing loss by analyzing the effect of masker level and masker type on word recognition in normal-hearing listeners

Background

Ipsilateral masking can be defined as masking that is presented in the same ear as the target word. Clinicians can utilize ipsilateral masking in order to assess the effectiveness of a hearing aid or cochlear implant for listening in a noisy environment. Within ipsilateral masking, this research study examined the thresholds of hearing with informational and energetic masking. Informational masking occurs when a participant cannot focus on the target word because several words or conversations are being presented simultaneously. Typically, children are more susceptible to informational masking[1]. On the other hand, energetic masking occurs when a participant is unable to hear the target word due peripheral response to the noise swamping out response to the target.

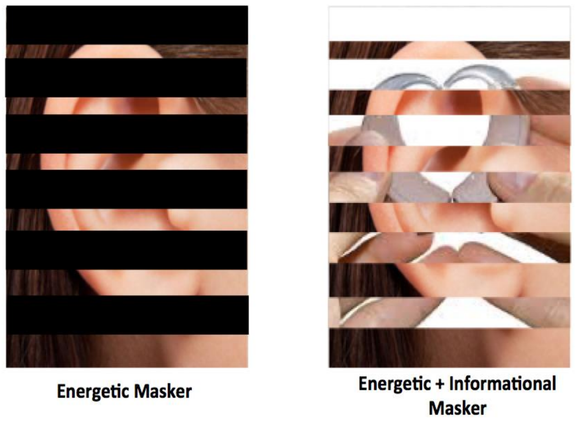

Figure 1: Difference in Presentation of Energetic and Informational Masking

A restricted frequency enables a participant to better identify the target sound. When a masker is presented at a lower frequency than the target sound, cochlear tuning becomes poorer[2]. As a result, the participant is not easily able to distinguish the target sound accompanied by a masker.

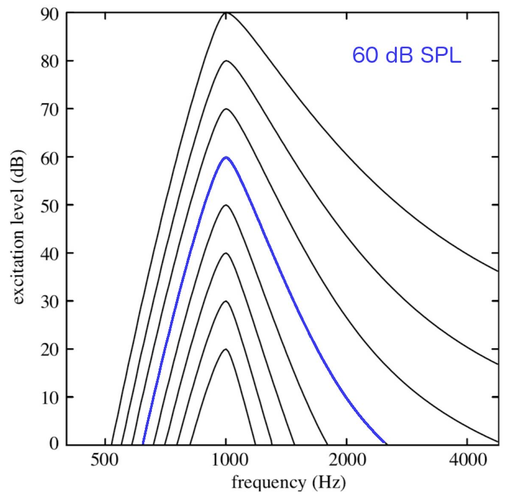

Figure 5[2]: Excitation patterns for a 1000 Hz sinusoid at levels ranging from 20 to 90 dB SPL in 10 dB steps

Methods

Six undergraduate students were given a tympanogram and a hearing screening with extended high frequency headphones in a soundproof booth to ensure that the participants had normal hearing. Participants kept the high frequency headphones on and were instructed to select the image on an iPad of the word that they heard. We then estimated the threshold signal level associated with 71% correct word recognition. The two-talker masker tested for the effect of informational masking while the speech shape noise masker tested for the effect of energetic masking. The experiment was controlled using MatLab. The six conditions as follows were presented in a random order and the threshold values were recorded:

Two-Talker Masker	SSN Masker
75 dB SPL	75 dB SPL
60 dB SPL	60 dB SPL
45 dB SPL	45 dB SPL

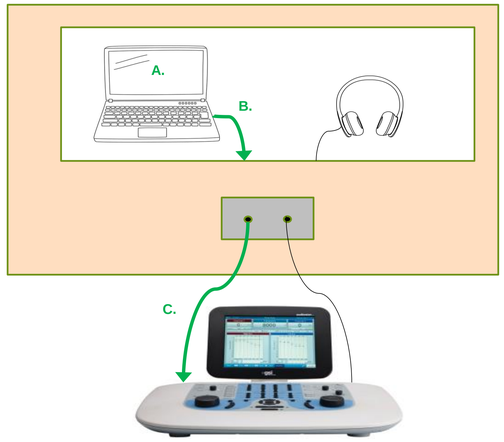

Figure 2: Diagram explaining the audiometer and iPad setup

Results

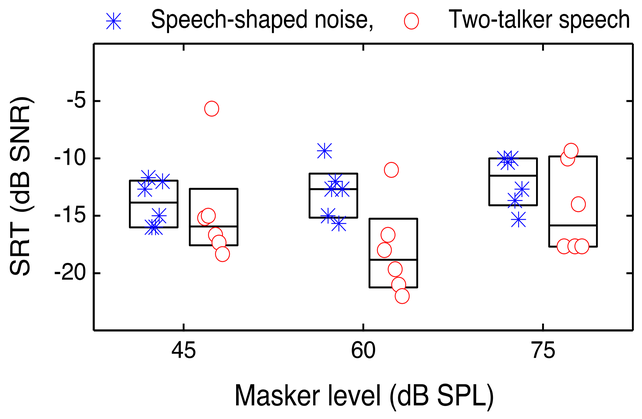

Figure 3: Box-plot of SRT data in SSN and two-talker masker conditions

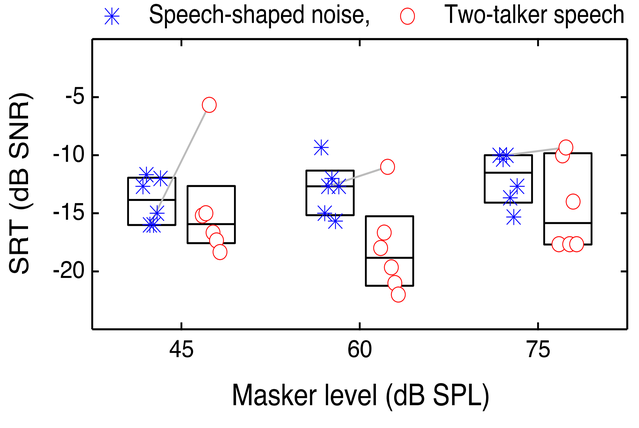

Figure 4: Box-plot with lines indicating data of one participant who was particularly susceptible to informational masking.

Discussion

The SRT in dB SNR was relatively consistent despite a 30 dB difference in presentation level from 75 to 45 dB. There is a trend for thresholds to increase with increasing level in the noise masker (2 dB), and for better performance at 60 dB SPL than 45 or 75 dB SPL in the speech masker (3 dB). More data are needed to confirm these trends. The level effect in SSN is consistent with what we know about cochlear filtering. Though six participants is a small sample size, these results can serve as preliminary data for audiologists working with patients that have hearing loss. Audiologists can use this data as a reference for normal hearing in order to analyze how informational and energetic masking influences the threshold values for patients with hearing loss.

References

1. *Wightman, F. Informational Masking of Speech in Children: Effects of Ipsilateral and Contralateral Distracters. Heuser Hearing Institute and Department of Psychological and Brain Sciences, 2005*

2. *Moore, B. Basic Auditory Processes Involved in the Analysis of Speech Sounds*

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