AGE-RELATED CHANGES IN INFORMATIONAL MASKING

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1. INTRODUCTION

In spite of noisy backgrounds, people can listen to an important sound and reject irrelevant, distracting information. In order to separate relevant from irrelevant information during simultaneously-presented sounds, people have to focus their attention on the target and ignore the distracter. Various theories or models attempt to explain auditory information processing when attention is engaged. All of them refer to informational masking (e.g. Allan and Whitman, 1995; Slawinski and Scharf, 1998; Ison, Virag, Allen, and Hammond, 2002).

The present experiments measured the effect of a masker's presence (distracter) and its uncertainty on detection of a target sound. Results of previous work performed by Neff, Dethlefs and Jestead (1995) have shown that when the frequency content of a multitone masker (distracter) changes, detection of the target sound deteriorates markedly. Previous work by Slawinski and Scharf (1998) focused on tonal stimuli and suggested that low intensity, uncertain, randomized distracters (four) were able to increase a target's threshold in a similar way for older and younger participants.

The present study augmented the previous study by Slawinski and Scharf (1998), while incorporating a few changes:

a. Two distracters were presented only instead of four distracters.
b. Speech syllables were presented, in addition to tonal stimuli.

In order to explore age-related differences in processing important sounds (targets), two experiments were designed. The two experiments differed in the type of target sound used, distracters, as well as background noise. Each experiment was designed to find the detection threshold of the target sound (syllable-ga or pure tone-1kHz). Results of both experiments were obtained using an adaptive procedure. It was hypothesized that:

1. Target detection thresholds will be a function of age.
2. Participants will show different change in threshold as a function of age depending on a type of presented stimuli.

2. METHOD

2.1. Participants

Twenty-eight older adults (64-90 years old) and twenty-five young, untrained students (21-32 years old) served as participants. All participants had normal hearing (15 dB or better for audiometric frequencies from 500 Hz to 8kHz) and were free from any neurological problems.

Older participants were paid $10.00 Cdn. per hour for their participation. Younger participants obtained a bonus credit towards a chosen course for their participation.

2.2. Stimuli

All stimuli were synthesized. The speech-like stimuli (syllables) were synthesized using software KLSYN 88a implemented on a PowerMac computer. Intonation contour of speech-like stimuli syllables imitated naturally spoken syllables. However, the intonation contour was the same for all type of syllables.

The pure-tones were generated on-line by the Tucker Davis Technology modules and software implemented on a Vectra PC computer. The targets' intensity changed according to an adaptive procedure, while the distracters' intensity was maintained constant during both experiments.

2.3 Procedure

Participants were tested individually in an anechoic chamber. Sound was presented binaurally via headphones of flat frequency characteristics. At the very beginning of the each experiment, participants were presented with practice sessions until full understanding of the task was achieved. Target sounds were initially provided to the participants at the maximal level of 80 dB SPL by the Tucker-Davis Instruments' hardware and software. During the experiments, delivery of the intensity level of stimuli was controlled by the Tucker-Davis Instruments' hardware and software as well as a customized software.

An experimental session began with a single-track adaptive procedure to determine the 79.4% threshold in background noise alone, separately for the targets and each of the distracters. Next, a two-track interleaved adaptive procedure was used to determine the 79.4% thresholds for targets in

the presence of each of the two corresponding distracters. On a given trial, each distracter was a different distracter in each interval. Once the threshold had been determined with a given distracter, that distracter was no longer presented with the target's sound but could be presented in the other, noise-only interval.

Background noise varied depending on the experiment. The background noise was a cafeteria noise during presentation of speech-like stimuli and a band-pass white noise (300 Hz to 1800 Hz) for pure-tone stimuli. Background noise was presented at 60 dB SPL.

Participants' answers were collected by a PC computer HP VECTRA.

Participants were able to pause and relax anytime during the experiments.

3. RESULTS

Results of both experiments are presented together. Detection thresholds of target sounds of the elderly were compared to those of young participants.

When differences in hearing were not taken into account, the effect of age was significant in detecting targets in the presence of the corresponding distracter. This difference disappeared when hearing was taken into account $F(1,51)=.41$ at $p=0.525$.

The MANCOVA, using the audiometric averages as a covariate was performed on the detection threshold values. Younger and older adults showed similar performance patterns (means and SD for finding the syllable and tonal target). However, both age groups demonstrated higher detection thresholds when speech sounds were presented compared to that of tonal sounds ($F(1,51)=27.97$ at $p=0.000$.

Thresholds were also higher for detection of the syllable [ga] in a presence of the syllable [da] than in presence of syllable [ba]. The detection of tonal stimulus was poorer in presence of high frequency distracter (2 kHZ) than in presence of low frequency distracter (500 Hz).

4. DISCUSSION

Our hypotheses were partially supported by the findings of this study. Older listeners required more intense targets in order to detect it compared to young participants. Secondly, both age groups followed the same pattern of performance.

Thus, it seems that older people are probably making more errors when detecting the syllable [ga] than young adults. Moreover, the syllable [ga] acoustically is more similar to the syllable [da], thus, it was not surprising that all participants had more problems to detect the target [ga] in presence of [da] distracter.

The results of the study by Slawinski and Scharf (1998) that showed that detection of a tonal target is more influenced by the presence of a higher frequency distracter than the target itself, were also supported. However, currently it is difficult to provide an explanation for this effect.

5. REFERENCES

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