Spatial Aspects of Contextual Plasticity in Sound Localization

Beáta Tomorióva1, Luboš Hládek2, Rudolf Andoga1, Norbert Kopčo1

1 Technical University of Košice, Slovakia 2 Pavol Jozef Šafárik University, Košice, Slovakia

Introduction

Background
Various studies show that spatial hearing is an adaptive process, i.e. the mapping of spatial cues onto a 3D sound source is not fixed but can undergo changes (Moore et al., 2004). Changes in localization of a target can be elicited also by another sound, for example: - by the distraction of a noise that overlaps in time with target (Bransch et al., 2002), - by the distraction of another sound which precedes the target (Carle et al., 2001). Kopco et al. (2009) studied localization of a transient sound source preceded by identical distractor sounds. We could show that localization of the target was modified by the adaptation to the distractor sound.

Methods

Setup (see Fig. 2)
- headphones spaced in arc around subject,
- 112° between speakers, - subject orientated either frontally (left/right) or mediately relative to the middle speaker (black arrows),
- orientation fixed within a run.

Stimuli
- target: 2 ms frozen noise burst,
- distractor: identical as target, presented before target on experimental trials, coming always from the middle speaker,
- distractor-to-target interval fixed at 23 ms.

Experimental Procedure
- 4 sessions, each of 7 runs,
- 2 types of runs (see Fig. 3)
- experimental run: 25% (20 trials) randomly interleaved with control run, 75% control run, - control trials: sound alone.

Subjects
Seven normal-hearing subjects participated.

Previous studies

Kopco et al. (2007) (Figure 1A)
Experiment consisted of trials with target preceded by distractor with no-distractor trials used with trials where target was preceded by distractor.

Kopco et al. (2009) (Figure 1B)
Added baseline run consisting of only target trials as a reference for estimation of the effect. Studied also temporal profile of adaptation.

Results

Responses in all types of runs reveal a shift of responses towards center of spatial range (Figure 1B).

Contextual effect is similar for lateral and medial orientation.

Contextual bias (up to 5-10 degrees away from distractor observed in the subregion where the context was presented (see target positions #1-3: pink line and #5-7 for blue line), including distractor position (target position #4).

Kopco et al. (2009) confirmed (Figure 1C)
No bias observed in subregion where context was not presented.

Summary and Discussion

Contextual effect could be bottom-up (adaptation of neural spatial representation) or top-down effect (change in attention on context or other). Results support top-down supression because the effect is not dependent only on distractor energy (8 click and noise had same energy and total duration but different contextual biases).

References