Exploring Different Training Methods to Induce Reweighting of Binaural Localization Cues

Maike Ferber¹,²,³, Norbert Kopčo³, Aaron Seitz⁴, Bernhard Labak⁵
¹University of Vienna, Austria; ²Acoustics Research Institute, Austrian Academy of Sciences; ³Pavol Jozef Šafárik University in Košice, Slovak Republic; ⁴University of California, Riverside, USA

Introduction

- Adaptation to altered sound localization cues has been extensively studied, highlighting the plasticity of the auditory system. (see Carder, 2014, and King et al., 2011, for reviews)
- This adaptation can either be a result of the establishment of a new spatial map of the altered cues (Keating, Dahmen, & King, 2015; Skuse-Cunningham, Dahmen, & Held, 1996) or a stronger relative weighting of unaltered compared to altered cues, referred to as reweighting. (Keating, Dahmen, & King, 2013; Kumpf, Kozik, & King, 2010)
- However, selective reweighting of the binaural cues interaural time difference (ITD) and interaural level difference (ILD) has not yet been shown.
- We seek to fill this gap and to explore different training methods to induce ITD/ILD reweighting.

Methods

<table>
<thead>
<tr>
<th>Experiment I</th>
<th>Experiment II</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Design</strong></td>
<td><strong>Design</strong></td>
</tr>
<tr>
<td>VR Localization Training (7 days)</td>
<td>Absolute Discrimination Training (3 days)</td>
</tr>
<tr>
<td><strong>Groups</strong></td>
<td><strong>Groups</strong></td>
</tr>
<tr>
<td>ITD Target Group</td>
<td>ITD Target Group</td>
</tr>
<tr>
<td>ILD Target Group</td>
<td>Absolute Discrimination</td>
</tr>
<tr>
<td>Relative Discrimination (ILD Target)</td>
<td>Relative Discrimination (ILD Target)</td>
</tr>
<tr>
<td><strong>Participants</strong></td>
<td><strong>Participants</strong></td>
</tr>
<tr>
<td>2 x 10 participants (10 female)</td>
<td>2 x 8 participants (11 female)</td>
</tr>
</tbody>
</table>

Stimuli

- Narrow-band (1 octave wide) noise; center frequency: 2.8 kHz
- Duration: 500 ms (including 50 ms on/off ramps)
- Independent combinations of ITD and ILD

Task

- Reference position = sound presentation
- Locating sound via head turn
- Visual feedback = find and confirm cube location
- Reference position = sound presentation in combination with feedback
- Confirm location

Analysis

- We controlled for observed response compression in the posttest using each participant’s linear regression (stimulus vs response location) slopes.
- No control for compression required.

Cue weight:

- Slope of a linear regression [binaural cue disparity vs lateralization bias (i.e., the differences between response and cue locations in the direction of the other cue’s locations); no intercept]

[see Kacelnik & Vallortigara, 2002]

Results

- Significant increase in ILD weights for the ILD target group
- Significant decrease in ILD weights for the ITD target group
- Significant group difference in the posttest

Conclusions

- ITD/ILD reweighting can be achieved with a localization training in VR.
- This has interesting implications, e.g., for making ITD information better usable by bilateral cochlear-implant listeners.

References and Support

- Support: EU project H2020 IMPACT (grant agreement #636226).