Spectral Weighting of Binaural Cues: Effect of Bandwidth and Stream Segregation

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Introduction

It is hypothesized that binaural information is integrated over frequencies in the binaural system to lateralize sounds (Buell and Hafter, 1991; Woods and Colburn, 1992) using a spectral weighting function. Furthermore it is hypothesized that this weighting is not fixed but can vary depending on the signal properties and on the acoustical context of the sound.

Method and Stimuli

- Weights derived with a logistic regression analysis
- Perceptually important (loudness)
- Binary output (left/right lateralization)
- Probably described as

\[
p = \frac{1}{1 + e^{-z}}
\]

- With \( z \) being the weights leading and the linear model

\[
y = a + \beta x
\]

\( \beta \) are the weights across the conditions and the weights for the frequency weights. The weights are normalized relative to their mean values.

Hypothesis

It is hypothesized that binaural information is integrated over frequencies in the binaural system to lateralize sounds (Buell and Hafter, 1991; Woods and Colburn, 1992) using a spectral weighting function. Furthermore it is hypothesized that this weighting is not fixed but can vary depending on the signal properties and on the acoustical context of the sound.

Experiment 1: Static condition

10 normal hearing listeners

Figure 2: Sketch of the subconditions in experiment 1. The black bars represent the noise bands with binaural information (ITD or ILD). The blank bars represent interferer without uncorrelated noise. 4 subconditions were used to investigate the influence of the most outer frequency bands. In all 11 noise bands contained ITD/ILD information, i.e. in the 1 or 2 most outer bands were set to uncorrelated noise and in subcondition 3 the 2 most outer bands were removed.

Experiment 2: Streaming condition

5 normal hearing listeners (subgroup from experiment 1)

Figure 4: Sketch of the time/frequency representation of the signal used in the streaming conditions with a on/offset of 120 ms (red box). The arrowheads indicate all used frequencies from this experiment. The black bars represent the target signal as used in the static experiment. The grey bars represent the pre-cursors and co-located noise, individually out of phase.

Table 1: Conditions of the experiment

<table>
<thead>
<tr>
<th>Time (ms)</th>
<th>Frequency (Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-120</td>
<td>442, 603, 803, 1051, 1358, 1739, 3525, 5544</td>
</tr>
<tr>
<td>120-150</td>
<td>442, 603, 803, 1051, 1358, 1739, 3525, 5544</td>
</tr>
</tbody>
</table>

Discussion and conclusions

Results obtained different to what would be expected from the duplex theory

- Spectrally most outer bands play a special role
- Streaming leads to an increase in weights
- Release from interference?
- Increase in weight only when binaural information available
- At low frequencies for ITD
- At all frequencies for ILD

Literature

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