The Relative Importance of ITDs & ILDs to Spatial Auditory Processing:

Understanding spatial processing deficits in hearing-impaired people

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Introduction

- Spatial processing is the ability to selectively attend to target speech coming from one direction while suppressing sounds from other directions.
- Can be measured using the Listening in Spatialized Noise – Sentences Test (LiSN-S) spatial advantage score.
- Hearing-impaired people show deficits in spatial processing ability even when speech is amplified
- We need to understand why hearing-impaired people have poor spatial processing ability before we can address these deficits.

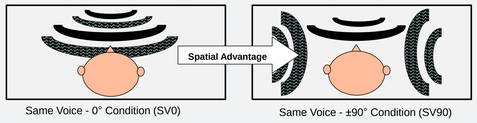

Fig. 1- Calculation of LiSN-S Spatial Advantage

Does successful spatial processing rely on ITDs or ILDs?

Aim: To investigate the proportional contribution of Interaural Time Differences (ITDs) and Interaural Level Differences (ILDs) to spatial processing in normal hearers.

Method:

- 12 normal hearing adults (24 – 53 years) assessed on LiSN-S stimuli with ITDs, ILDs, or both.

Results:

- No sig difference between spatial advantage in ILDs only and ITD&ILD condition ($p = 0.94$)
- Spatial advantage significantly reduced in ITDs only condition ($p < 0.01$)

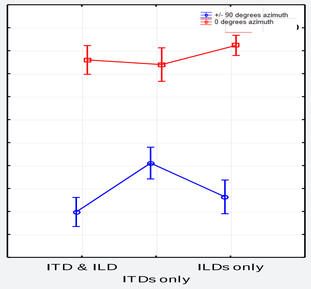

Fig. 2 – SRT by spatial location as a function of LiSN-S version

- *ILDs appear to be the dominant cues used by normal hearers to achieve spatial processing*.

Does reduced audibility cause spatial processing deficits in the hearing-impaired?

Aim: To investigate if reduced audibility, compared to normal hearers, causes the reduction in spatial processing ability seen in hearing-impaired people.

Method:

- 12 normal hearing adults (25 – 47 years)
- Frequency specific filtering (attenuation) applied to LiSN-S to match audibility experienced by average hearing-impaired listener in Glyde et al (in press).

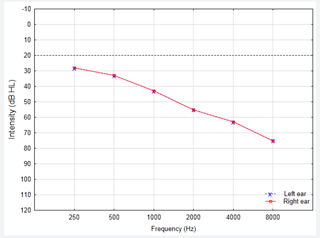

Fig. 3 – Average audiogram from Glyde et al. (in press)

Results:

- Data was compared to results of a subset of hearing-impaired participants (n = 16) from Glyde et al (in press) and normal-hearing adults (n = 96) from Cameron et al (2011).
- Significantly reduced spatial advantage in reduced audibility dataset compared to normal hearers data ($p < 0.01$) & compared to hearing-impaired data ($p = 0.01$)

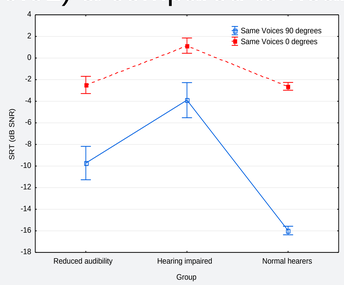

Fig. 4 – SRT by spatial location as a function of group

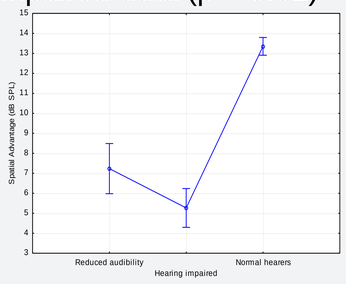

Fig. 5 – Spatial advantage by group

- *Reduced audibility explains a large portion of observed spatial processing deficits*.

Is spatial processing facilitated by cross-ear dip listening?

Aim: To investigate whether cross-ear dip listening is the method through which normal-hearers use ILDs and whether widened auditory bands reduces hearing-impaired people's spatial processing ability.

Method:

- 22 normal hearing adults (18 – 29 years)
- Tested on SV0º & SV±90º + CENH & CEHI

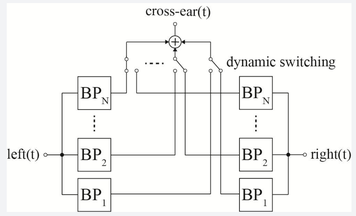

Fig. 6 – Auditory filterbank (NH/HI) and ear switching mechanism used to develop CENH and CEHI stimuli

Results:

- CENH sig. better than SV0º ($p < 0.01$)
- CENH sig. worse than SV±90º ($p < 0.01$)
- A small but sig. difference between CENH and CEHI ($p = 0.02$)

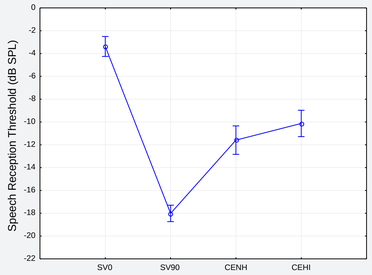

Fig. 7 – SRT by condition

- *Cross-ear dip listening explains some, but not all, of the benefit gained from spatial processing.*
- *Widened auditory bands have a small but sig. impact on performance.*