The Effect of Aging and Hearing Impairment on Spatial Processing

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Background Information

- A high percentage of hearing-impaired people struggle to understand speech in the presence of background noise (Dubno et al., 2002).
- Difficulty understanding speech should be considered one of the most incapacitating elements of hearing loss, given its potential to cause feelings of isolation (CHABA, 1988).
- The exact cause of this difficulty remains unclear.
- Spatial processing is the ability to selectively attend to sounds arriving from one direction while suppressing sounds arriving from other directions.
- The Listening in Spatialized Noise – Sentences Test (LiSN-S) is an adaptive speech in noise test developed to assess spatial processing ability in normal-hearing people.
- The LiSN-S has been adapted to include a prescribed gain amplifier so it can be used to assess the hearing-impaired.

Aims

1. Investigate the effect of age, cognition and degree of hearing loss on spatial processing ability.
2. Examine the relationship between spatial processing ability and self-report measures of listening difficulty in background noise.

Methodology

Participants: 15 children and 65 adults (aged 7 to 89 years) with up to a moderately-severe sensorineural hearing loss in the worse ear.

Procedure: The following tests were completed in a 1.5 hr session:

- Pure tone audiometry
- Real ear insertion gain
- The Neurobehavioral Cognitive Status Examination (COGNISTAT) – Adult participants only
- The LiSN-S with prescribed gain amplifier
- Speech, Spatial & Qualities of Hearing questionnaire (SSQ) – Adult participants only
- The Listening Inventory For Education: Student Appraisal (L.I.F.E.) – Child participants only

Results

- Multiple regression analysis showed a significant correlation between 4FAHL and spatial advantage (partial $r^2=0.66, p < 0.001$)
- No significant correlation between age and spatial advantage (partial $r^2=0.06, p = 0.1$)
- Age is significantly correlated with the high cue condition of the LiSN-S (partial $r^2=0.17, p = 0.001$)
- No significant correlation between cognition and spatial advantage was found once hearing loss and age were controlled for (partial $r^2=0.00, p = 0.7$)
- A significant correlation was found between self-reported listening difficulty in noise and spatial advantage (p < 0.01)
- However, the relationship between self-reported listening difficulty in noise and spatial advantage was no longer significant when hearing impairment was included in the analysis (p = 0.133)

Conclusions

- Greater hearing impairment is correlated with increased spatial processing difficulties.
- Age does not affect spatial processing abilities in hearing-impaired people.
- There is a strong relationship between spatial advantage and self-reported listening difficulties. However the extent to which listening difficulties are caused by reduced spatial advantage and the extent to which they are caused by other consequences of hearing loss cannot be established from these data because of the strong correlations between all variables.

Future Directions

- Can deficits experienced by hearing-impaired people in spatial processing be remediated using deficit-specific auditory training?
- What is the cause of spatial processing deficits in hearing-impaired people?

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