The Real Benefit of Asymetrical Fittings

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BACKGROUND

Numerous studies have been published regarding the effectiveness of directional microphones. Although many studies yielded positive benefit of directional microphones for understanding speech in noise (Nielsen, 1973; Valente et al, 1995; Wouters et al, 1999; Pumford et al, 2000; Walden et al, 2000), other findings report the number one complaint among hearing aid users is understanding speech in noise (Kochkin, 2002). Even if directional microphones are operating in a optimal manner, people often do not select the correct program on the instrument (Kochkin, 2000). Although automatic/adaptive switching microphone modes should eliminate the patient's need to switch between omni- and directional-mic programs, the hearing aid directionality mode is often selected incorrectly (Walden et al, 2004).

PURPOSE AND HYPOTHESIS

Asymmetrical fittings of bilateral hearing loss place a directional-microphone on one ear (focus ear) and an omni-directional microphone on the other (monitor) ear. While some studies have shown no difference between asymmetrical fittings and bilateral directionality (Benter, et al., 2004; Cord, et al., 2007), other studies have called into question the efficacy of asymmetrical fittings (Mackinzie & Lutman, 2005). While asymmetrical fittings do not propose to improve upon directional microphone technology *per se*, they do attempt to alleviate some of the significant drawbacks to achieving full advantage of directional microphone technology in the field: eliminate the need for user-controlled manual switching (which users don't do 30% of the time) and eliminate incorrect machine mode switching failures.

Research Questions:

1. In noisy environments, do listeners show a decrease in word recognition performance when one hearing aid of a binaural directional fitting is changed to omni-directional?
2. In listening environments where listeners prefer the ease-of-listening of a binaural omni-directional fit, is there a reduction in "ease-of-listening" ratings by changing one hearing aid microphone setting to directional?

MATERIALS AND METHODS

The literature was reviewed to identify studies related to asymmetrical directional hearing aid fittings. ***Specifically, studies were selected that evaluated the speech understanding results of bilateral versus asymmetrical directional hearing aid fittings in the presence of non-correlated noise*** (since listeners rarely encounter noise sources that are temporally-correlated with the target speech signal). Studies that used any type of correlated noise were not included. Additionally, studies conducted in quiet environments were not selected for comparison. Each condition of a particular study was examined as if it were an independent experimental result.

Data reported in the studies were pooled and subjected to a meta-analysis. Meta analysis is a set of statistical techniques for combining quantitative information from different studies to derive an overall estimate of a particular treatment. In this case, "does changing one ear of a bilateral directional hearing aid fitting cause a decrease in word recognition performance in noise?" was our first research question. Additionally, "does changing from a bilateral omni-directional hearing aid fitting to an asymmetrical hearing aid fitting reduce a listener's ease-of-listening in quiet environments?" was a second research question examined.

Subject selection included experienced hearing aid wearers, aged 50-84 across studies.

Research Question 1 was answered by examining two measures: 1) mean percent correct on word recognition tasks tested in the presence of non-correlated background noise and 2) signal-to-noise ration required for 50% sentence identification accuracy on speech-in-noise tests (e.g., HINT).

The studies used to answer Research Question 1 were:

Bentler R, Egge J, Tubbs J, Dittberner A & Flamme G (2004)
Cord MT, Walden BE, Surr RK, Dittberner AB. (2007)
Donham & Paschall (2008)
Hornsby B & Ricketts T (2007)
Mackinzie E & Lutman M (2005)

Research Question 2 was answered also by meta analysis of reported listener ease –of-listening rating. These ratings comprised the 'EC' scale of the APHAB and other ratings of ease-of-communication scales published in each study.

The studies used to answer Research Question 2 were:

Bentler R, Egge J, Tubbs J, Dittberner A & Flamme G (2004)
Cord MT, Walden BE, Surr RK, Dittberner AB. (2007).
Whitmer WM, Dittberner AB, Coughlin M, Dominguez M. (2006).
Mackinzie E & Lutman M (2005)

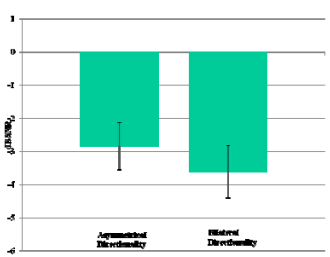


Figure 1. Question 1 – SNR. Note overlapped error bars (no significant difference)

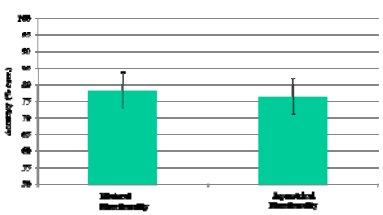


Figure 2. Question 1 – WRS. Note overlapped error bars (no significant difference)

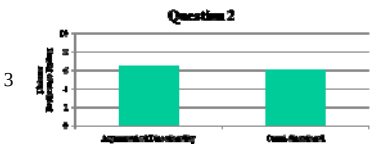
RESULTS

Figure 1 shows the results for the meta-analysis of signal-to-noise ratio analysis. The error bars represent the 95% confidence range. Overlapping CI bars indicate no significant difference between the conditions

Figure 2 shows the results for the meta-analysis of the word recognition accuracy analysis. The error bars represent the 95% confidence range. Overlapping CI bars indicate no significant difference between the conditions

Figure 3 below reports the ease-of-listening ratings across studies. As can be seen, listeners preferred the asymmetrical directionality over omni-directional fittings, even in environments that favored omni processing.

Figure 3



CONCLUSIONS

The meta-analysis of quantitative data shows that switching one ear of a bilateral directional fitting to omni-directional does not change the listener's speech understanding performance compared to bilateral directional fittings. Additionally, having one ear in directional mode does not reduce the ease-of listening ratings of listeners in environments where omni-directional processing is usually preferred. Thus, the data support the contention that an asymmetrical directional microphone fitting provides patients with a single program setting for having the best chance to understand speech in noisy environments, without giving up listening comfort in environments where directionality is not warranted or preferred.

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