Field Study News

October 2013

DuoPhone for children

Significantly improved speech understanding on the phone

A recent study by Dr. Jace Wolfe, from the Hearts for Hearing Foundation in Oklahoma USA, revealed that the use of the Phonak DuoPhone feature over a monaural phone program significantly improved speech understanding for children ages 2-14 years while using a landline telephone. With DuoPhone, the signal is picked up by one hearing aid (microphone or telecoil) and is wirelessly streamed to the receiving hearing aid on the other ear. This way the signal is heard in both ears simultaneously. For the older children, 6-14 years, speech recognition improved on average by 32% with DuoPhone compared to hearing the phone signal monaurally. For the younger children, 2 to 5 years old, the average improvement was 19.5%.

Objective

The objective of this study was 1) to evaluate speech recognition on the telephone in quiet and in noise for a group of children with hearing loss and 2) to evaluate the benefit of DuoPhone for children's speech understanding while using the telephone.

Introduction

The standard of care for children with bilateral hearing loss is the provision of hearing technology for both ears. The benefits of binaural hearing are well established and include enhanced loudness perception and sound quality from binaural summation, binaural redundancy, improved localization and speech recognition in quiet and especially in noise (Carhart, 1965)[1]; (Davis & Haggard, 1982)[2]; (Dermody & Byrne, 1975)[3]; (Harris, 1965)[4]; (Shaw, 1974)[6].

There has been very little research done to examine how children with hearing loss understand speech over the telephone. (Picou & Ricketts, 2011; 2013)[7,8] recently reported that speech recognition for adults is significantly improved when listening to a telephone speech signal with two ears using a streaming device, compared to performance with one ear alone. On average, bilateral listening on the phone resulted in a 22% improvement in speech recognition when compared to the unilateral condition.

(Kochkin, 2010)[9] found that approximately 30% of adult hearing aid users reported that they were less than satisfied with their ability to understand speech over the telephone. To address this need, most hearing aid manufacturers offer access via an accessory which enables streaming from a telephone. An alternative solution that doesn't require an additional accessory and allows use of both mobile and landline phones, is the Phonak DuoPhone feature. With DuoPhone, the signal is captured by the hearing aid microphone or telecoil on one side and is transmitted to the other side wirelessly. In addition, the microphones on the receiving hearing aid are attenuated to further improve the signal to noise ratio. This is possible thanks to the unique Binaural VoiceStream Technology™ which allows transmission of the full audio signal in real time. DuoPhone can be activated either manually or automatically and has the following key advantages:

1) The hearing aid wearer is able to receive the telephone signal bilaterally.
2) It can be used with both landline and mobile telephones.
3) It requires no additional interface.
4) The input signal can be either the microphone or telecoil.

PHONAK
life is on

Study Design

Twenty-four children participated in this study. Fourteen were between the ages of 6 to 14 (mean = 9.5, standard deviation = 2.8); hereafter referred to as the 'older group', and ten were between the ages of 2 to 5 (mean = 3.9, standard deviation = 1.0); hereafter referred to as the 'younger group'. Inclusion criteria for study participation were as follows:

1) Bilateral hearing loss with a better-ear four-frequency pure-tone average between 35-75 dB HL.
2) Symmetrical hearing loss with no more than a 20 dB difference in air-conduction thresholds between ears at 500, 1000, 2000 and 4000 Hz.
3) Full-time users of binaural amplification fitted to DSL targets.
4) English as a primary language.
5) Expressive and receptive spoken language abilities within one year of their chronological age.
6) All subjects were fitted with Phonak Bolero Q90-M13 hearing aids, except for subject #003 in the younger group who had a four-frequency pure-tone average of 81 dB HL in the poorer ear and was fitted with Phonak Bolero Q90-SP hearing aids.

In both the Phonak default acoustic telephone program and the telecoil+microphone program, the Audioscan RM500SL analyzer was used to conduct probe microphone measures. The output of the hearing aid was assessed while a recorded 60 dB SPL *Standard Speech* signal was presented over the telephone and one of the study examiners held the receiver of the telephone handset next to the microphone of the hearing aid. Adjustments were made to the hearing aid gain to ensure that the output of both the acoustic and telecoil programs were within (+/- 3 dB) of each other (figure 1). This protocol was performed for both groups. For the older group, the hearing aid output was confirmed via Real Ear probe microphone measures. For the younger group, RECDs were obtained and simulated probe microphone measures were used. Two telecoil programs were created from these measures. One program was a monaural telecoil program and the second telecoil program had the DuoPhone feature enabled to allow streaming of the telephone signal to both ears simultaneously.

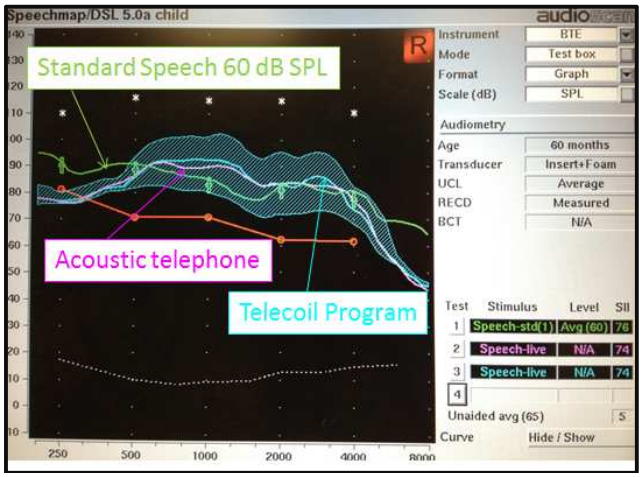

Fig. 1
An example of the output of one hearing aid for both the acoustic telephone program and the telecoil program compared to the Audioscan RM500SL standard speech signal

Speech recognition over the telephone in quiet was measured for all 24 children. However, only 22 of the 24 children completed speech recognition testing over the telephone in the presence of competing noise as two children from the younger group fatigued before testing could be completed. Testing was conducted with the monaural phone condition (telecoil) and with the binaural phone condition (DuoPhone via telecoil) for each test participant. Telecoil was chosen for the monaural condition rather than the acoustic phone program for several reasons: 1) it was noted that the children had difficulty maintaining the correct positioning of the handset for the duration of testing and 2) when using an acoustic phone program, holding the phone receiver only 1 inch (or 2.5 cm) away from the optimum location can potentially decrease the output of the telephone signal by 15 dB (Holmes & Chase, 1985)[5]. Although telecoil was the condition tested, a direct comparison between acoustic phone program and telecoil was not formally assessed.
For the older group, speech recognition was assessed via recorded consonant-vowel-nucleus-consonant (CNC) words presented via a compact disc player stereo system coupled to a landline telephone by way of an audio-telephone-handset interface. Speech recognition in noise was then evaluated in the presence of uncorrelated classroom noise (Schafer & Thibodeau, 2006)[10] at 50 dB(A) at the location of the subject from four loudspeakers located in the corners of the room. The order in which testing was conducted (e.g., monaural versus DuoPhone) was counter-balanced.

For the younger group, speech recognition was assessed in each condition (quiet and noise) with a half-list of words Northwestern University – Children's Perception of Speech (NU-CHIPs) test words. The test stimuli were presented in an open-set format and presented by the same female talker throughout the study. The female talker was located in a different room to the child and presented the words over the landline telephone. The live presentation of the NU-CHIPs words was monitored via a sound level meter 1 meter from the female talker and peaked

at 60 dB(A). Similar to the older group, speech recognition was assessed using uncorrelated classroom noise (Schafer & Thibodeau, 2006)[10] presented at 55 dB(A) at the location of the subject from four loudspeakers located in the corners of the room. The order in which testing was conducted (e.g., monaural versus DuoPhone) was counter-balanced.

Results

Mean word-recognition scores for the older and younger children are provided in Figures 2 and 3, respectively. Speech intelligibility for older children improved by 29% in quiet and by 35% in noise when using DuoPhone rather than the monaural phone condition. Speech intelligibility for younger children improved by 18% in quiet and by 21% in noise when using DuoPhone rather than the monaural phone condition. A two-by-two repeated measures analysis of variance revealed a significant difference in average speech score between conditions (quiet versus noise) and also between telephone program (monaural versus DuoPhone) for both age groups.

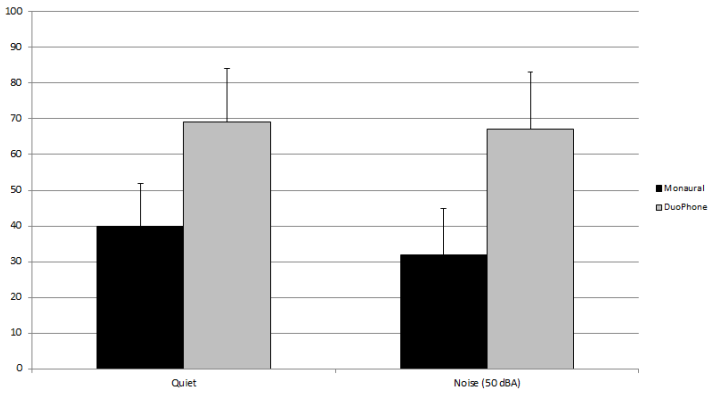

Fig. 2
Comparison of mean word recognition scores for the older children (6-14 years) between a monaural phone program to DuoPhone

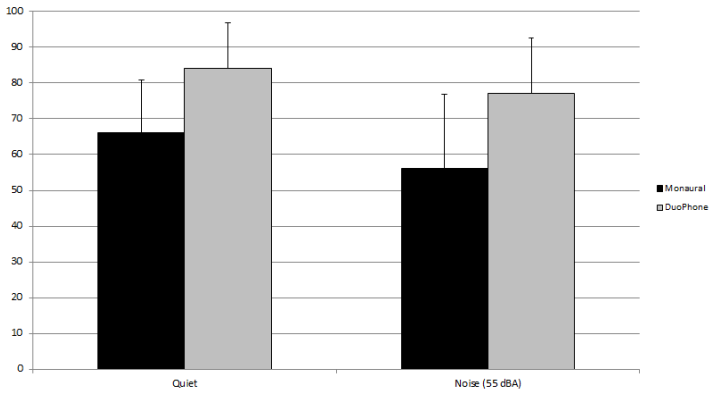

Fig. 3
Comparison of mean word recognition scores for the younger children (2-5 years) between a monaural phone program to DuoPhone

Conclusion

The study results indicate that children with hearing loss receive substantial benefit from the DuoPhone feature in quiet and in the presence of background noise. This feature uses wireless binaural streaming to transmit an audio signal from one hearing aid that is near the telephone handset to the receiving hearing aid on the opposite side of the head. In addition, the microphones on the receiving hearing aid are attenuated to improve the signal to noise ratio. The older children's word recognition scores in quiet and in noise improved, on average by 32% with DuoPhone, while the younger children's recognition of monitored live speech in quiet and in noise improved on average by 19.5%. This improvement is similar to the improvement Picou and Ricketts (2011; 2013)[7,8] reported when comparing binaural to monaural telephone performance for adults.

References

1. Carhart R (1965) Monaural and binaural discrimination in against competing sentences. International Journal of Audiology; 4(3): 5-10.

2. Davis A, Haggard M (1982) Some implications of audiological measures in the population for binaural aiding strategies. Scandinavian Audiology Supplement; 15: 167-179.

3. Dermody P, Byrne D (1975) Loudness summation with binaural hearing aids. Scandinavian Audiology; 2(1): 23-28.

4. Harris J D (1965) Monaural and binaural speech intelligibility and the stereophonic effect based upon temporal cues. The Laryngoscope; 75: 428-446.

5. Holmes A, Chase N (1985) Listening ability with a telephone adapter. Hearing Instruments, 36:16-17

6. Shaw E (1974) Acoustic response of external ear replica at various angles of incidence. Journal of the Acoustical Society of America; 55: 432(A).

7. Picou E, Ricketts T A (2011) Comparison of Wireless and Acoustic Hearing Aid-Based Telephone Listening Strategies. Ear & Hearing; 32(2): 209-220.

8. Picou E, Ricketts T (2013) Efficacy of Hearing-Aid Based Telephone Strategies for Listeners with Moderate-to-Severe Hearing Loss. Journal of the American Academy of Audiology; 24: 59-70.

9. Kochkin S (2010) MarkeTrak VIII: Consumer satisfaction with hearing aids is slowly increasing. The Hearing Journal; 63(1): 19-27.

10. Schafer E, Thibodeau L (2006) Speech recognition in noise in children with cochlear implants while listening in bilateral, bimodal, and FM-system arrangements. American Journal of Audiology; 15: 114-116.