Output Measures of Assistive Technology Headphones

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INTRODUCTION

Lightweight headphones are often offered with assistive listening devices (ALDs) provided by public establishments to meet the needs of persons with hearing loss. However, there are no regulations regarding the verification of the output of these devices (Thibodeau & Wallace, 2014). The purpose of this study was to establish a reliable methodology for measuring the output of headphones for personal listening systems. Because the ANSI S3.47 Standard for Hearing Assistive Technology does not specify a particular coupling method for lightweight headphones, a coupling system designed for ALD headphones, Simulated Head and Pinna System (SHAP) was evaluated. SHAP was designed to be an affordable system to integrate with existing clinical equipment for measure output of lightweight headphones.

PURPOSE

The primary objective of this study was to examine the reliability of a Simulated Head and Pinna System as a coupling method for measuring output of headphones typically used with assistive listening devices in public venues.

EQUIPMENT

Coupling System (see Figure 1):

- Simulated Head and Pinna (SHAP) System designed to mimic average adult head dimensions
- Male pinna by GRAS used to support headphones
- Half inch to one inch adapter used to attach Fonix microphone

Measurement System (see Figure 2):

- Fonix FP35 Hearing Aid Analyzer for stimulus presentation and sound pressure level measurement from the headphones

ALD System and Headset (see Figure 3):

- Phonak Roger Inspiro set to verification mode
- Roger MyLink set to full volume connected to each headphone

Figure 1: Simulated Head And Pinna system

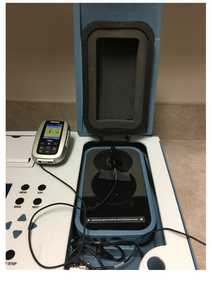

Figure 2: Setup of Fonix Hearing Aid Analyzer with Phonak Roger

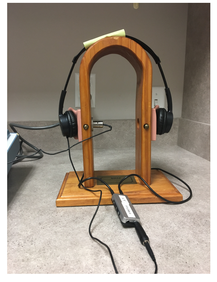

Figure 3: MyLink and headset on SHAP

METHODS

Measurement Stimuli: A 70-dB SPL, composite-speech signal from the Fonix FP35 Hearing Aid Analyzer was delivered to the Inspiro-lapel microphone placed inside the test box.

Measurement Procedure: A total of 72 trials were conducted with 9 headphones by 5 different manufacturers. To assess the reliability of the measurement, two trials were completed for each side of each headphone; headphones were placed and the output was measured, headphones were then removed, replaced, and re-measured.

RESULTS

Table 1 shows the RMS output for the composite-signal input to the Fonix microphone for each headphone and each trial.

- Output Across Manufacturers: The average RMS output across the 9 headphones was 85.8 dB SPL and ranged from 74 to 93 dB SPL.
- Test-retest Variability: The RMS output difference between trials for the same headphone did not exceed ±2 dB.
- Right vs. Left Variability: Between right and left sides of the same headphones, the differences ranged from 0 to 8 dB.
- Variability across headphones: Differences in output across headphones from different manufacturers might be expected. However, even between headphones from the same manufacturer, there is variability of up to 7 dB.

	RMS OUTPUT dB SPL			
	Right Headphone		Left Headphone	
Headphone	Trial 1	Trial 2	Trial 1	Trial 2
A-1	90	90	92	92
A-2	90	92	91	91
A-3	91	92	93	92
A-4	89	90	91	90
B	79	78	74	74
C-1	80	81	86	88
C-2	87	87	86	86
D	87	87	86	86
E	90	90	88	89

Table 1: Outputs of right and left headsets to composite signal presented through Phonak Roger Inspiro transmitter, to Roger MyLink connected to the headphone which was placed on Simulated Head and Pinna System. The letters indicate different manufacturers for the headphones.

APPLICATION FOR ALDs IN PUBLIC PLACES

- To apply this procedure to ALDs used at a local theatre, similar measurements were made with 13 headphones that had been retired from the theater company's use
- All headphones were of the same manufacturer and style, with varying signs of use
- Average output for these headphones was 85 dB SPL
- Variability between right and left sides of headphones ranged from 0 to 8 dB
- Variability across the different headphone was up to 12 dB

	RMS OUTPUT dB SPL of Retired Headsets				
Headset	Right	Left	Headset	Right	Left
1	82	82	7	88	86
2	84	85	8	89	87
3	86	79	9	87	84
4	83	91	10	84	84
5	89	85	11	87	82
6	87	85	12	88	86

Table 2: Average dB SPL output of headphones retired from a local theater company

SUMMARY & CONCLUSION

- Differences across potential headphones that could be used with ALDs was up to 19 dB
- Differences between right and left headphones was up to 8 dB
- These findings suggest need to evaluate headphone output to ensure ALD users receive optimal benefit
- Differences across systems could be even greater if multiple ALDs were tested
- The test-retest variability with the SHAP system was +-2 dB and suggest the SHAP is a useful coupler for these measurements
- These results highlight the need to make systematic output measures of ALDs in public venues

REERENCES

American National Standards Institute. ANSI/ASA S3.47 American National Standard Specification of Performance Measurement of Hearing Assistance Devices/Systems. 2014.

Thibodeau, L., Wallace, S. (2014). Guidelines and standards for wireless technology for individuals with hearing loss. *Seminars in Hearing, 35*(3). 159-167. doi: 10.1044/s-0034-1383501