

Evaluation of the Harmony™ Sound Processor in Children

Background

Previous research has demonstrated that advances in cochlear implant technology improve outcomes in adults and children. The CD-quality front-end signal processing and new external controls offered by the Harmony behind-the-ear (BTE) sound processor result in improved sound quality and satisfaction ratings for adult users (Séguin et al, 2006). Few, if any, other reports describe improvements in listening benefits resulting solely from changing the sound processor.

In addition to enhanced front-end signal processing, the Harmony has a built-in status LED that allows parents and teachers to monitor battery status and microphone function. The Harmony accommodates several earhook options including the T-Mic[®] (Figure 1), the iConnect (for wireless FM use), and Direct Connect (for use of external audio devices such as CD players). These features, along with greater power efficiency and longer battery life, make the Harmony a more practical sound processor for children compared with previous technologies.

The purpose of this investigation is to examine the potential listening benefits of the Harmony in children who are 4–12 years of age. Another aspect of the study will explore the potential for increased speech understanding in noise and improved sound localization through use of the T-Mic option as demonstrated in previous adult studies (Soli et al, 2006; Soli et al, 2005). The present study will be conducted at two centers in the United States—Midwest Ear Institute (Missouri) and the University of Louisville (Kentucky).

Study Overview

A prospective, within-subjects, repeated-measures design will be used to examine speech recognition performance with the Harmony compared with previous generation sound processors. Subjects are tested with their own processors to establish baseline performance. After a two-week period using the Harmony, subjects return for follow-up evaluation. Subjects entering the study who already use the Harmony processor will be tested using the Harmony with the small T-Mic during their follow-up visit. Some subjects also will be asked to evaluate different PowerCel™ batteries or the Direct Connect earhook and cable in everyday situations.



Figure 1. The Harmony BTE sound processor with the small T-Mic[®] attached.

Speech perception tests will be presented in quiet as well as in background noise with and without spatial separation. Included in the speech perception battery are the BKB-SIN and CRISP tests. The BKB-SIN (Etymotic Research, 2005) is a speech-in-noise test that uses Bamford-Kowal-Bench (BKB) (Bench et al, 1979) sentences, recorded in four-talker babble to estimate signal-to-noise ratio loss (SNR loss). Performance is expressed as a SNR loss value. The SNR loss is the increased signal-to-noise ratio required by a listener to understand speech in noise compared with normal performance.

The Children’s Realistic Intelligibility and Speech Perception (CRISP) (Garadat & Litovsky, 2005; Litovsky, 2003) assessment employs two syllables (spondees) using a closed-set task designed for children ages four years and older. The stimuli are presented in quiet and in the presence of a two-talker noise competitor. Adaptive testing is performed wherein a speech reception threshold is obtained, defined as the lowest presentation level that yields a 50% score.

In addition to speech recognition testing, parents will complete a questionnaire that captures their processor preference and rating of everyday listening benefits as well as comfort and ease of use. Sample items from this questionnaire are shown in Table 1.

Table 1. Sample items from the parental questionnaire.

Questionnaire Item	Response Options/Scale									
Based on your child’s listening experience, which do you prefer?	<input type="checkbox"/> Harmony <input type="checkbox"/> Own Processor (or processor prior to Harmony)									
How strong is your preference? (1 to 10 scale)	1	2	3	4	5	6	7	8	9	10
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	dissatisfied			satisfied				very satisfied		
What is the <i>primary</i> reason for your preference? (Choose only one.)	<input type="checkbox"/> Listening performance <input type="checkbox"/> Wearing comfort <input type="checkbox"/> Ease of use <input type="checkbox"/> Cosmetics <input type="checkbox"/> Resistance to loss and damage									
With the preferred processor, my child:	(Complete each statement using the scale below. NA means no opportunity to evaluate.)									
	strongly disagree	disagree	neutral	agree	strongly agree	NA				
<input type="checkbox"/> Understands speech better in quiet.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> Understands speech better in background noise.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> Understands speech better on the telephone.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> Is better able to distinguish environmental sounds.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> Appears to be more interested in music.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> Speaks with better voice quality.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> Speaks with greater clarity.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
Rate your general satisfaction with the built-in status LED to monitor Harmony functions: lock, battery level, and microphone. (Scale 1-5.)	1	2	3	4	5					
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>					
	dissatisfied		satisfied		very satisfied					
Rate your child’s comfort wearing Harmony. (Scale 1-5.)	1	2	3	4	5					
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>					
	uncomfortable		comfortable		very comfortable					
Rate your general satisfaction with the Harmony as an ear-level processor for your child. (Scale 1-5.)	1	2	3	4	5					
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>					
	dissatisfied		satisfied		very satisfied					

References

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