Document Cover Sheet

Project Number		
Document Title	Report on 2012 HLAA Convention NB vs WB Speech Study	
Source	Rehabilitation Engineering Research Center (RERC) on Telecommunications Access	
Contact	Linda Kozma-Spytek Technology Access Program Gallaudet University 800 Florida Ave, NE Washington, DC 20002	Phone: 202 651 5676 Fax: Email: linda.kozma-spytek@gallaudet.edu
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Abstract

In the summer of 2012 at the HLAA convention, testing was completed with a group of 22 cochlear implantees that indicated access to wideband audio improved speech understanding (in quiet) over speech understanding using typical narrowband telephone audio. This finding is consistent with work by other researchers. In addition, an advantage was found for wideband audio among participants in terms of lowering the mental effort expended during completion of the speech understanding task compared to that expended during task completion for narrow band audio testing. The method and results of this study are summarized below (see pages 1-5).

Hearing device users benefit from access to a magnetic signal for telephone listening. While testing at the HLAA convention was done only in microphone mode, there is no reason why consumers that can access wideband audio through their hearing device would not also benefit from a wideband magnetic signal if they prefer to use telecoil coupling of their hearing device to a telephone. Typical amplified telecoils have a flat response in the high frequency region above 1k Hz through approximately 10k Hz (see page 6). Hearing devices that have extended frequency bandwidth capabilities like cochlear implants and some hearing aids would permit access to this information for individuals with hearing loss who use these devices and prefer to couple to a handset via their telecoil. All three cochlear implant manufacturers include telecoils in their products, and telecoils are included in many hearing aid models.

Summary

Testing of narrowband vs wideband telephone speech was completed at the 2012 HLAA convention with a group of 22 cochlear implantees. Results showed access to wideband telephone audio improved speech understanding (in quiet) over speech understanding using typical narrowband telephone audio. In addition, an advantage was found for wideband audio among participants in terms of lowering the mental effort expended during completion of the speech understanding task compared to that expended during task completion for narrow band audio testing. The method and the results are provided, in brief, below.

Method:

Stimuli

Stimuli for the experiment were drawn from the Computer Assisted Speech Perception Evaluation and Training tool, or CASPER (Boothroyd et al., 1987). CASPER is a system for evaluation of speech in audio, visual (lipreading) and combined modes that consist of 72 sentence sets. Sentence sets 1 – 8 were used to prepare the stimuli, with 2 different sets used for each test condition. For each study participant, speech understanding was tested using CASPER sentence sets in two audio-only conditions, narrowband telephone speech (AMR NB at a bit rate of 12.2 kBit/s) and wideband telephone speech (G.722.2 at a bit rate of 23.85 kBit/s), (and several audio-visual conditions, which will not be reported here).

Test Set-Up

Testing conditions followed ITU-T P.910 in terms of lighting and positioning of the viewer. Participants repeated the sentences that they heard through the microphone of their cochlear implant; using a test set up that simulated cell phone listening via speakerphone with an average presentation level of ~70 dB SPL at the location of the listeners head. The subjects' responses were scored as the number of words correctly repeated per set (out of 102 total words) for each condition. Each administration of one sentence set per condition took approximately 5 minutes. Presentation of conditions was counterbalanced across subjects.

Following the completion of testing for one sentence set/one condition, the online version of the SMEQ was administered. The Subjective Mental Effort Questionnaire (SMEQ) provides a post-task rating of the mental effort an individual expends in completing a task. It consists of a single scale with nine labels from "Not at all hard to do" to "Tremendously hard to do." Participants moved a slider with a mouse to the point in the scale that represented their judgment of task difficulty. The slider "widget" calculated and provided the scale value selected by the participant. Higher values indicate greater perceived task difficulty.

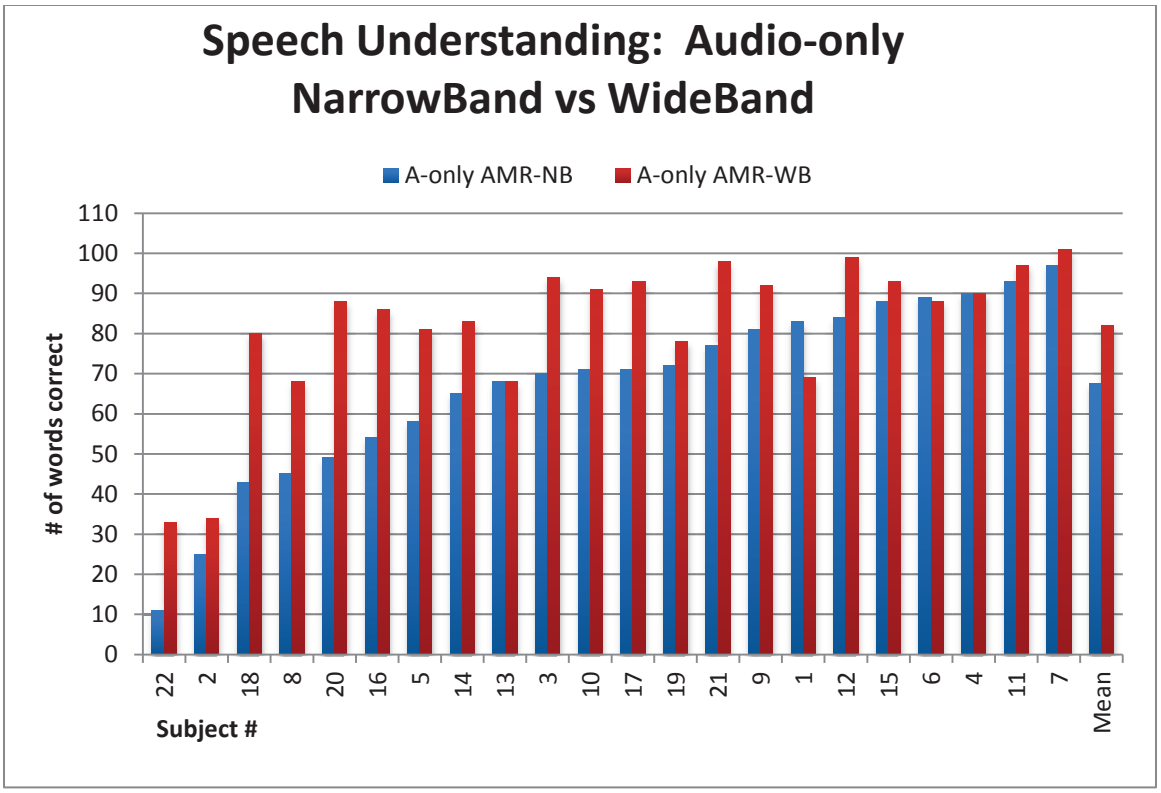
1.1.1 Results:

1.1.2 Speech Understanding

A paired t-test was performed between conditions comparing narrowband (NB) and wideband (WB) audio for the audio only conditions. WB audio resulted in better speech understanding compared to NB audio. The difference in number of words correct WAS statistically significant [$t(21) = 5.10$ $p < .001$]. The observed difference is 14.6 words, with a 95% confidence interval around the difference of 8.6 to 20.47. The graph below shows mean results, as well as, results for individual participants.

Descriptive Statistics for each Group

	Mean	StDev	N	SE
WB Audio	82.0	18	22	3.9
NB Audio	67.5	22	22	4.8

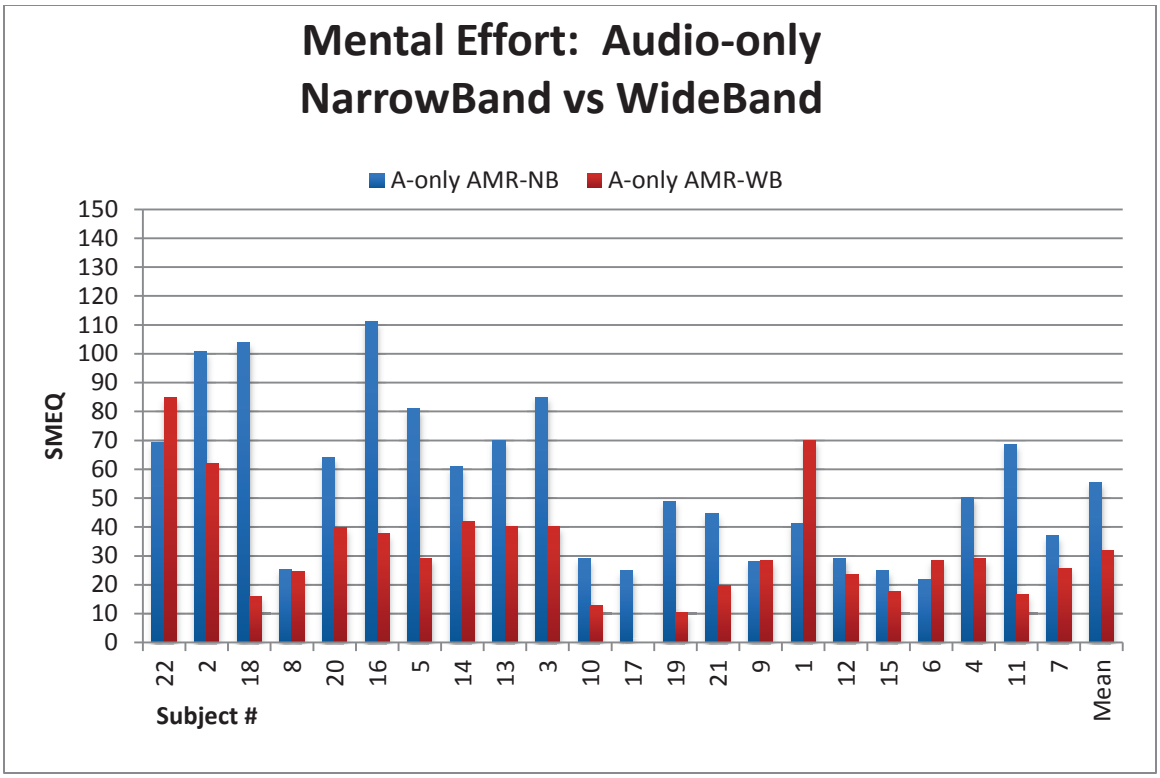


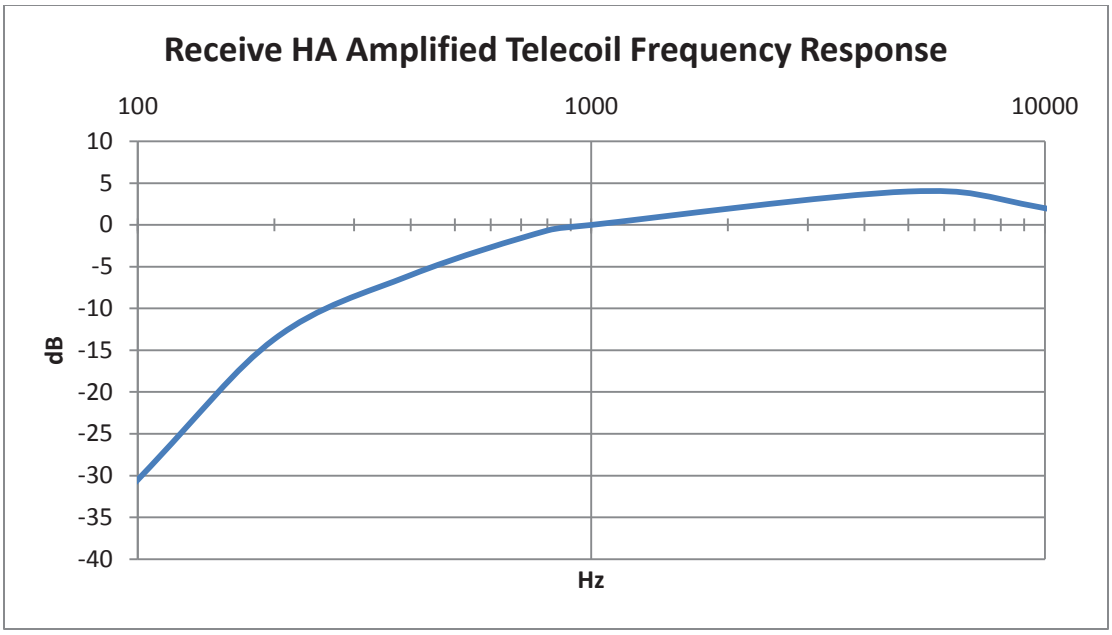
1.1.3 Mental Effort

A paired t-test was performed between conditions comparing NB and WB audio for the audio only conditions. Speech understanding with wideband audio had a lower average perceived difficulty compared to narrowband audio. The difference between perceived difficulty (SMEQ) **is** statistically significant [t(21) = 3.99 p <.001]. The observed difference is 23.7 points, with a 95% confidence interval around the difference of 11.35 to 35.99. The graph below shows mean results, as well as, results for individual participants.

Descriptive Statistics for each Group

	Mean	StDev	N	SE
WB Audio	31.8	20	22	4.3
NB Audio	55.4	28	22	6.0


Mental Effort: Audio-only
NarrowBand vs WideBand
A-only AMR-NB
A-only AMR-WB
SMEQ
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
22
2
18
8
20
16
5
14
13
3
10
17
19
21
9
1
12
15
6
4
11
7
Mean
Subject #



freq	dB
100.0	-17.0
125.9	-15.1
158.5	-13.1
199.5	-11.2
251.2	-9.3
316.2	-7.4
398.1	-5.6
501.2	-4.0
631.0	-2.4
794.3	-1.1
1000.0	0.0
1259.0	0.9
1585.0	1.6
1995.0	2.0
2512.0	2.4
3162.0	2.6
3981.0	2.7
5012.0	2.8
6310.0	2.9
7943.0	2.9
10000.0	3.0