Effects of Frequency Compression on Children’s Detection of Unfamiliar Words
Andrea Pittman, Ashley Pederson, & Madalyn Rash
Pediatric Amplification Laboratory, Arizona State University

Word Learning Model

| Detection | Identifying an unknown word |
| Configuration | Forming a stable acoustic representation |
| Forming a semantic representation |
| Engagement | Using the new word with other words |

Purpose
1) To examine the non-word detection of children and adults with hearing loss (HL) compared to children and adults with normal hearing (NH).
2) To determine the degree to which a frequency-compressed signal is comparable to that of a wide-band and a narrow-band signal.

Method

Participants

| Participants | Normal Hearing (controls) |
| | 33 – Children (8-12 years) |
| | 24 – Adults (53-74 years) |
| Hearing Loss | 19 – Children (8-12 years) |
| | 20 – Adults (53-77 years) |

Stimuli

Three lists of 18 sentences were used. Each sentence contained 4 mono-syllabic words. One or two non-words were created by replacing one phoneme with another phoneme having similar phonotactic probability. “Small kids need help” 0 non-words
“Small mids need help” 1 non-word
“Small kids need help” 2 non-words
Each list contained equal numbers of sentences having zero, one, or two non-words.

Stimulus conditions (Fig 2):
1) Wide-band: 9 kHz
2) Narrow-band: 4 kHz
3) NLFC: 2780 Hz cross-over 3:1 compression ratio

Procedure

Stimuli were presented binaurally under earphones and frequency-shaped to accommodate elevated hearing thresholds. Participants counted the non-words in each sentence and selected the appropriate number displayed on a touch-screen monitor. Correct responses were reinforced using a video game format like the puzzle in Fig 3. No reinforcement was provided for incorrect responses.

Results

Data were reduced to three categories of performance:
1) Overall performance in proportion correct (filled bars)
2) Under-detection: Proportion of errors due to counting too few non-words (hatched bars)
3) Over-detection: Proportion of errors due to counting too many non-words (open bars).

One-way analyses of variance were conducted to compare the non-word detection of the children and the adults with HL against that of their NH counterparts.

For the adults with HL, non-word detection did not differ from that of the control group for any of the listening conditions.

For the children with HL, non-word detection was significantly poorer than the control group in every listening condition.

Similar results were found for under- but not over-detection.

For the adults and children with HL, post-hoc pair-wise comparisons (with Bonferroni adjustments) revealed a significant difference between the wide- and narrow-band listening conditions (I-J=1.122, p=0.004). Performance with NLFC did not differ from that in the WB and NB conditions.

Discussion

Both hearing loss and signal distortion affected the performance of the children but not the adults. Although the adults with personal hearing aids were not using frequency compression, their experience with amplification appeared to predispose them to the benefits of this form of amplification. For the children, performance was not affected by frequency compression experience.

Acknowledgements
This work was funded by a grant from Phonak AG.