Are receptive vocabulary and articulation skills associated with speech recognition in children with hearing loss?

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INTRODUCTION
A number of factors affect speech recognition in noise. Many of these factors, including degree of hearing loss, talker sex, and phonemic factors (i.e., voicing), have been well documented (Boothroyd, 1984). Underlying language skills, however, especially vocabulary and overall speech intelligibility, may also affect speech recognition performance (Lewis et al., 2010; Nittroer et al., 2013).

The purpose of this study was to examine the relationship between children’s speech recognition performance, receptive vocabulary, and articulation accuracy. The current study asks:
(a) what extent is receptive vocabulary associated with performance on speech-in-noise tasks? and
(b) to what extent is speech accuracy associated with performance on speech-in-noise tasks?

In addition, degree of hearing loss was considered.

METHODS
This study is part of a larger, study examining listening effort and fatigue in school-age CHL. As part of this larger study, children were administered a speech-and-language test battery that included measures of receptive vocabulary (Peabody Picture Vocabulary Test – 4th edition) and speech accuracy (Arizona Articulation Proficiency Scales – 3rd edition).

For the speech recognition tasks, children were seated in a reverberant room (RT60 = 0.6 seconds) and asked to repeat words presented from a loudspeaker located directly in front of them (approximately 1 meter). Verbal responses were recorded using a head-worn microphone. Speech recognition was measured using AB Isophonemic word lists (Boothroyd, 1988a,b). A 20-talker speech babble noise was presented continuously throughout the task at a fixed overall level of 56 dBA from loudspeakers situated at 45, 135, 225 and 315 degrees.

Speech levels were adjusted to create three, individualized, signal-to-noise ratios (SNRs) ranging in difficulty (-4 to +12 dB range; 30 words/condition). For this study, only data from the most favorable aided SNR condition were used. Verbal responses on the speech tasks were independently scored by two-trained research assistants (Tables 2 & 3). Discrepancies were resolved by a third research assistant.

RESULTS
Receptive vocabulary was not associated with performance on speech recognition-in-noise tasks (Words Correct r=.24, n.s.; Phonemes Correct r=.34, p>.06).

Articulation was associated with performance on the same task (Words Correct r=.46, p<.01; Phonemes Correct r=.42, p<.01).

Better ear PTA was not associated with performance (r=.09 and r=.06, n.s.), likely due to audibility of the speech and noise signals provided by the hearing aids.

DISCUSSION
Although a few studies have found a relationship between receptive vocabulary and laboratory speech recognition skill, these were not found in the current study. However, the relationship approached significance (p=.06).

Children were not told to expect real words in this study, so it is possible that vocabulary skills could affect speech recognition in real-world situations that are not captured in this study.

Children with concomitant speech sound disorders in this study demonstrated decreased accuracy in speech recognition tasks. For example, deaffractification (e.g., producing “bad” for “badge”) would result in a lowered words-correct and phonemes-correct score, although this is a normal substitution pattern for children with speech delays and disorders.

These errors may confound the results of audiologic testing if the child is asked to produce what they hear. Service providers should identify speech sound errors prior to speech recognition testing and modify materials or procedures as needed. In addition, using closed sets of materials may be helpful for children with severe articulation errors.

KEY REFERENCES

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