Speech Discrimination and Spatial Release from Masking in Toddlers with Cochlear Implants

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ABSTRACT

Bilateral cochlear implant (BCIs) have been shown to promote the development of spatial hearing skills in children and adults, but little is known about the role of bilateral stimulation in enhancing language and speech reception in infants and toddlers. In addition, the differences in performance between toddlers with unilateral cochlear implants (UCIs) and BCIs remains unexplored. We tested two hypotheses: (1) Toddlers with BCIs will discriminate more contrasts that differ in voice and/or place of articulation with higher accuracy than toddlers with UCIs because they “live two looks” at the speech signal. (2) Toddlers with BCIs will show more spatial release from masking than toddlers with UCIs.

METHOD

Hypothesis: Before entering the sound booth, the child receives exposure to the words and pictures used in the study through a live-voice familiarization. The experimenter presents each picture card to the child, while saying the accompanying phrase. The experimenter then places one picture on a puppet show game, so that the child learns to reach for a hidden toy when he/she hears, “I’m hiding under (stimulus).”

Presentation of stimuli on P/L is counterbalanced and randomized.

Method (cont.):

Prior to testing, we administered the Behavioral Identification Test (Bee) to toddlers to identify the presence or absence of hearing impairments. Toddlers with CI and UCIs were further divided into two groups based on the Bee Scores: low (Bee<8) and high (Bee≥8).

Participants:

Nine children who use CIs:
- At least 1 year of experience with CI at first visit
- Native English speaker
- Primary communication mode: oral, any CI device
- No diagnosed developmental disabilities
- Mean age: 31.6 months.

Three 24-36 mo. old toddlers with NH:
- Mean age: 30.8 months (8 Male, 5 Female)
- No history of hearing loss, ear infections, or other developmental delays
- Tympanometric and hearing screening performed

Speech discrimination results to date suggest that: (1) In implanted toddlers, speech discrimination abilities develop faster for temporally-based speech cues than spatiotemporal-based cues, but thus far, there is no measurable difference between UCI and BCI users. (2) The rate of development in NH toddlers is unknown because they perform equally well with all stimuli. NH toddlers show a benefit when the target and masker are spatially separated, while toddlers with BCIs and UCIs have not.

Spatial unmasking results:

Both methods used here are successful for testing 24-36 mo. old toddlers. While toddlers with NH perform near ceiling on speech discrimination and show benefit from spatial release of target and masker, toddlers with both BCIs and UCIs are extremely variable in their performance.

The three highest performers on both the Speech Discrimination and Spatial Unmasking tasks were implanted before 12 months of age and performed similarly to their hearing peers.

In implanted toddlers, speech discrimination abilities develop faster for temporally-based speech cues than spectrally-based cues, but thus far, there is no measurable difference between UCI and BCI users.