Introduction

Children with cochlear implants (CI’s) exhibit delays in speech production relative to normally hearing (NH) children. The contrast of /s/ and / ̃s/ may be difficult for children with CI’s because of the spectrum overlap above 4000 Hz. The current study uses transcription and acoustic analysis to describe the production of /s/ and / ̃s/ by children with CI’s.

Questions

- Do children with CI’s show less distinction between /s/ and / ̃s/ than NH children?
- Do children with CI’s produce /s/ and / ̃s/ with durations longer than those of NH children?

Method

Participants

- Eighteen 4- to 9-year old children with bilateral CI’s
- Twenty 2- to 5-year old NH children
- All children speak English as a first language

Stimuli

Stimuli included words with /s/ and / ̃s/ produced by children with CI’s. Further research is needed to determine what characteristics distinguish children who perform similarly to NH children from those who do not.

Procedure

- The children participated in an auditory word repetition task.
- The children were asked to repeat the stimuli word after the audio prompt. Productions were recorded for later analysis.

Analysis

Each initial consonant (and following vowel) were transcribed as correct or incorrect by a phonetically-trained native speaker transcriber. First speech moment (centroid) was calculated from the middle 40 ms of correct productions of /s/ and / ̃s/. The measure of centroid has been found to distinguish productions of /s/ and / ̃s/ with /s/ having a higher centroid than / ̃s/.

The centroids of /s/ produced by children with CI’s were lower in frequency than those of NH children, which may be due to CI’s providing poor frequency resolution above 4000 Hz.

Results from Transcription

Accuracy

The children with CI’s and the HA group showed similar accuracy levels for /s/ and / ̃s/.

Results from Duration Analysis

CI group compared to CA group

The children with CI’s showed longer durations of /s/ and / ̃s/ than the CA group.

Results from Spectral Analysis

Individual subjects

The two graphs below show centroids of /s/ and / ̃s/ produced by a child with CI’s and the two NH children who were matched on hearing age and chronological age. Letters indicate the vowels that followed /s/ and / ̃s/.

Conclusion

- The acoustic analysis revealed group differences that did not show up in the transcription analysis.
- Reduced variability was apparent in the centroids of /s/ and / ̃s/ produced by children with CI’s. Further research is needed to explain the causes of this reduced variability.
- Children with CI’s produced durations of /s/ and / ̃s/ that were longer than those of the children with NH.
- Children with CI’s exhibited a wide range of performance. Further research is needed to determine what characteristics distinguish children who perform similarly to NH children from those who do not.

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