The Influence of Word Characteristics on the Vocabulary of Children with Cochlear Implants

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Introduction

- Studies of typically developing normal hearing children show that knowledge of language structure influences which words are learned
- Specific measures of language structure:
  - Word length - the number of sounds in a word
  - Word frequency - the number of times a word is heard
  - Neighborhood density - the number of known words that sound similar to a given word
  - Phonotactic probability - the likelihood of occurrence of a sound sequence
- Typically developing normal hearing children tend to learn words with:
  - Few phonemes
  - High frequency
  - High density
  - Low probability
    (Hollich, et al., 2002; Storkel, 2004, 2009)
- Why are children with CIs of particular interest?
  - The input they receive differs from normal hearing children, potentially affecting which words are learned versus which words are not learned.

Research Questions

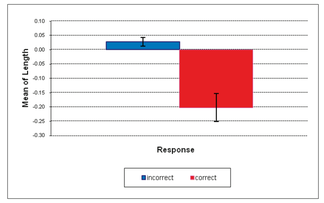
- For children with CIs, do the known words differ from the unknown words on any of the word characteristics?
- Do these effects vary across groups of children with CIs differing in language outcomes?

Methods

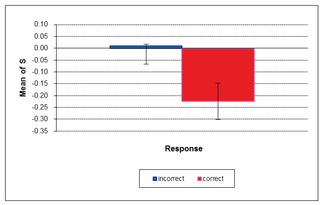
- A retrospective analysis of a subset of data from the Colorado longitudinal study of hearing loss (Yoshinaga-Itano, Baca, & Sedey, 2010)
- Participants: 3 Groups based on children's language outcomes from infancy to age 7
  - Gap closer: children whose language improved to an age-appropriate level
  - Age equivalent: children whose language was age-appropriate throughout the study
  - Delayed: children whose language was below age expectations at age 7
- Data:
  - CDIs at pre-CI (~1 year before CIs) and post-CI (~1 year after CIs) for 9 children
  - EOWPVT-3 at post-CI (~1 year after CIs) and at latest post CI (7 years of age) for 10 children
- Word characteristics for correct (i.e., known) versus incorrect (i.e., unknown) words were determined via an on-line child calculator (Storkel & Hoover, 2010)
  - Values were normalized using z-scores
- IVs: response, group, time
- DVs: word characteristics (i.e., word length, word frequency, neighborhood density, and phonotactic probability)
- Analysis: repeated measures ANOVA 2 Time (pre- vs. post-CI OR post- vs. latest post-CI) x 3 Group (gap closer vs. age-equivalent vs. delayed) x 2 Word Type (correct vs. incorrect)

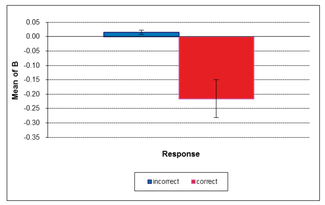
Results

- CDIs at pre-CI and post-CI
  - Significant main effect of response on word length: Correct words are significantly shorter than incorrect words.

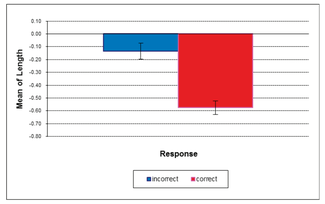


  - Significant main effect of response on phonotactic probability: Correct words are significantly rarer than incorrect words.

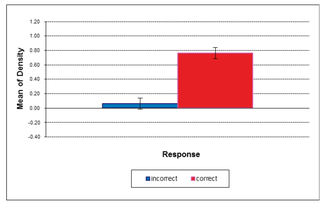




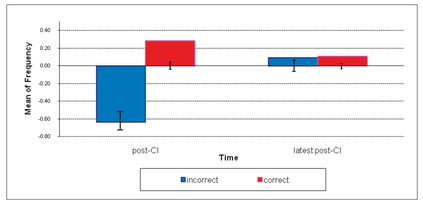
- EOWPVT-3 at post-CI and latest post-CI
  - Significant main effect of response on word length: Correct words are significantly shorter than incorrect words.



  - Significant main effect of response on word density: Correct words have significantly more neighbors than incorrect words.



  - Significant interaction of time and response on word frequency: Correct words have significantly higher frequency than incorrect words at post-CI, but there is no difference in word frequency between correct and incorrect words at latest post-CI.



Conclusions and Discussion

- Summary of Word Characteristics of Known Words by Children with CIs for Each Test

Word Characteristics	CDIs pre-CI and post-CI	EOWPVT-3 post-CI and latest post-CI
Word length	Short > Long*	Short > Long*
Word frequency	No significant effect	Frequent > Infrequent at post-CI*
Neighborhood density	No significant effect	Dense > Sparse *
S Phonotactic probability	Rare > Common*	No significant effect
B Phonotactic probability	Rare > Common*	No significant effect
Group Difference	**No**	**No**

S: Phonotactic probability for positional segment; B: Phonotactic probability for biphone; *p < .05

- The results of this study are consistent with those of previous studies although not all of the word characteristics were influential at the same test time.
- Word length: Effects of word length were robust appearing at all time points tested. Word length might influence initial processing of the phonological form of the novel word and the novel sound sequence in shorter words might be easier to be maintained in working memory.
- Word frequency: Children with CIs at post-CI seem to learn words with higher frequency better than low frequency, possibly aided by the multiple exposures.
- Neighborhood density: Dense characteristic seems to emerge relatively late compared to children with normal hearing [e.g., Hollich et al., (2002): 17-months old; Storkel (2004, 2009): 16- to 30-months old]. This late high-density advantage might indicate delayed lexical acquisition in children with HL.
- Phonotactic probability: As children with CIs learn more words, the effect of phonotactic probability may decrease over time.
- Group difference: Although no group differences were found in word characteristics of known words by children with CIs, there were medium and large effect sizes in the interaction of Group and Response for word frequency, neighborhood density, and phonotactic probability for positional segmental at pre- and post-CI; and for neighborhood density and two measures of phonotactic probability at post- and latest post-CI, indicating the possibility for group differences in larger samples.

References

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