

# Bimodal language processing in profoundly deaf children with a cochlear implant

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## Introduction

- Continuing debate on effects of signed input on spoken language outcomes in CI children
- Majority of studies compared children in different educational settings<sup>1</sup>
- Few studies assessed children in both modalities
- Unfounded suggestions of cross-modal interference in sign-supported speech<sup>2</sup>

## Goals of the present study

1. Obtain insight into the relation between speech and sign perception within CI children
2. Examine the interaction between the spoken and signed modality during speech perception

## 1. Modality relations

### Participants

- CI children (CI)  
n=15, mean age: 5;8, mean age at implantation: 1;8
- Children with normal hearing (NHC)  
n=10, mean age: 5;10, non-signers
- Adults with normal hearing (L2A)  
n=12, mean age: 21;9, 1-2 years signing experience

### Task

- Picture-matching using minimal non-word/non-sign pairs
  - Familiarized with pictures and spoken/signed labels of novel objects (familiar included objects/labels as filler stimuli)
  - 2-alternative forced choice test trials

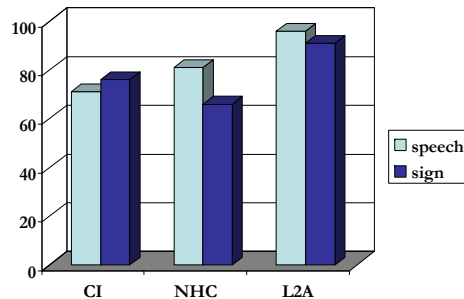
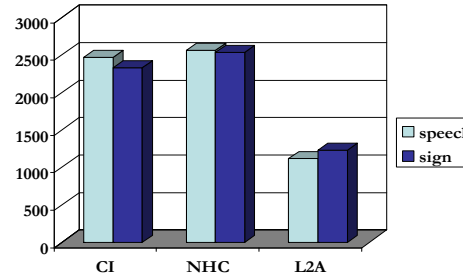


Fig. 1A  
Mean % correct in both language modalities

Fig. 1B  
Mean response latency (msec) in both language modalities



## Results

- % correct (Fig. 1A): higher scores in spoken modality than signed modality for NH children ( $p < .01$ ) and L2 adults ( $p < .05$ ), but not for CI children ( $p = .23$ )
- latency (Fig. 1B): similar latencies in spoken and signed modality for all groups

## Correlations

- CI children with higher scores and faster responses in the spoken modality also had higher scores and faster responses in the signed modality ( $\% \text{ correct: } r = .67, p < .05$ ;  $\text{latency: } r = .92, p < .01$ )
- Children implanted at a younger age scored higher in both modalities than children implanted at a later age ( $\text{speech: } r = -.57, p = .07$ ;  $\text{sign: } r = -.65, p < .05$ )

## 2. Modality interactions

### Participants

- CI children (CI)  
n=8, mean age: 6;11, mean age at implantation: 1;10

### Task

- Spoken word recognition in unimodal and bimodal condition
  - Similar design as picture-matching task under 1
  - Familiar (+fam) and novel (-fam) word pairs, phonologically similar (+sim) or dissimilar (-sim)
  - Speech condition: familiarized with words and tested on words
  - Bimodal condition: familiarized with bimodal stimuli, but tested on the word parts of the bimodal stimuli
  - Control conditions (not shown here): unimodal sign condition and post-test on the sign parts of the bimodal stimuli

Fig. 2A  
Mean % correct in the speech and bimodal condition

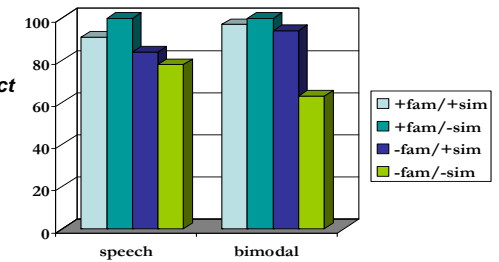
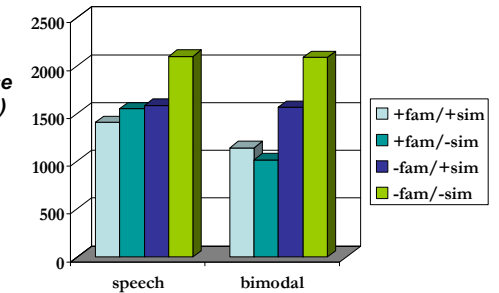


Fig. 2B  
Mean response latency (msec) in the speech and bimodal condition



## Results

- % correct (Fig. 2A): bimodal exposure leads to better retention of novel phonologically similar words (-fam/+sim,  $p = .06$ )
- latency (Fig. 2B): bimodal exposure leads to faster recognition of familiar phonologically similar words (+fam/+sim,  $p = .06$ )

## Conclusions

### 1. Relations between modalities

- Positive correlations argue against direct negative effects of signed input on spoken language outcomes
- Correlation age at implantation with sign perception scores suggests modality-independent effects of early intervention on language development

### 2. Interactions between modalities

- No evidence for cross-modal interference in spoken word recognition
- Cross-modal *facilitation* with confusable auditory stimuli

[1] Geers, A.E. (2006). Spoken language in children with cochlear implants. In Spencer, P.E., & Marschark, M. (Eds.). *Advances in the spoken language development of deaf and hard-of-hearing children* (pp.244-270). Oxford: Oxford University Press

[2] Bergeson, T.R., Pisoni, D.B., & Davis, R.O.A. (2005). Development of audiovisual comprehension skills in prelingually deaf children with cochlear implants. *Ear and Hearing*, 26, 149-164