Lexical access in primary school-aged children with hearing loss: voicing and place of articulation contrasts

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Background

- In spoken-word recognition:
  - words that partially match the speech signal are activated
  - when these lexical competitors no longer match, they are deactivated
- Compared to normal hearing (NH) adults, postlingually deafened adults using cochlear implants (CIs) may:
  - experience more and longer activation of lexical competitors
  - activate target words more slowly and hesitantly [e.g., 1,2]
- Some evidence that child CI users also experience more lexical competition than those with NH [3].
- Not much known about these processes in listeners with hearing aids (HAs).
- Perception of voicing and in particular place of articulation (PoA) contrasts seems especially hard for listeners with hearing loss (HL) [e.g., 4].

Research Questions

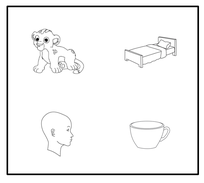
- How do difficulties perceiving voicing and PoA contrasts affect spoken-word recognition in children with HL?
- In particular, how do they affect:
  - the time course of lexical activation and competition?
  - the effort expended during spoken-word recognition?

Method

Participants: 29 monolingual Australian English-speaking children:
- 9 with HL (6 bilateral HAs, 1 CROS aid, 2 bilateral CIs; 3F, 6M), mean age 10;5 years (*SD* = 1;5)
- 20 with NH (9F, 11M), mean age 10;7 years (*SD* = 1;2)

Procedure: visual-world eyetracking paradigm with concurrent pupillometry

Dependent measures:
- response accuracy
- response time
- fixation proportions
- baseline-corrected pupil dilation



Stimuli:
- 72 spoken CVC words embedded in a carrier phrase
- visual displays containing two minimal pairs:
  - pair 1: target (e.g., cup) & onset competitor (e.g., cub)
  - pair 2: two distractors (e.g., head and bed)

Within-subject variable: type of minimal pair contrast
- voicing or PoA contrast between plosives (36 experimental trials)
- plosive contrasted with non-plosive (36 control trials)

Predictions

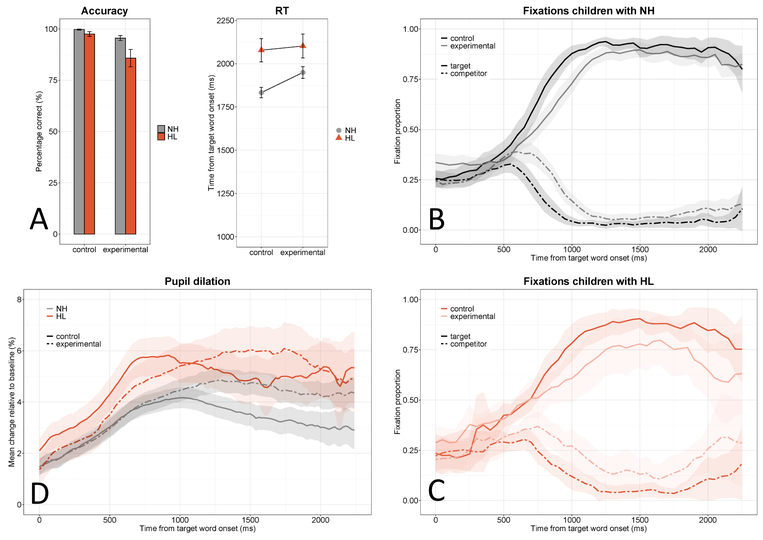
- Compared to those with NH, children with HL will have
  - lower accuracy & higher RT
  - slower target fixations and more/longer competitor fixations
  - greater baseline-corrected pupil dilation
- These differences will be greater in experimental than in control trials

Analysis and Results

Accuracy and RT (Figure A)
- Generalized linear mixed models
  - Accuracy: effect of group & contrast type
  - RT: effect of contrast type

Fixations to target and competitor (Figure B & C)
- Jack-knifed fixation data modelled with logistic curves (targets) and double Gaussian curves (competitors) [5] and estimates retrieved for individual participants' curve parameters [6]
- Linear mixed models on retrieved estimates of slope and maximum amplitude (target fixations) and offset amplitude (competitor fixations)
  - Target - slope: effect of group & contrast type
  - Target - maximum amplitude: effect of group & contrast type
  - Competitor - offset amplitude: effect of group & contrast type

Pupil dilation (Figure D)
- Measured as percentage change relative to baseline before start of each trial
- Linear mixed models on height of peak pupil dilation
  - Peak height: effect of group & contrast type



Discussion

- Compared to children with NH, **children with HL**
  - made more mistakes
  - were numerically but not statistically slower to click on the target image
  - experienced more prolonged lexical competition
  - fixated target images more hesitantly
  - expended more listening effort
- Compared to control trials, **voicing and PoA contrasts** led to
  - more mistakes
  - slower responses
  - longer interference from lexical competitors
  - more uncertainty in target fixations
  - more listening effort
- No significant interactions between group and contrast in any analysis
  - voicing and PoA contrasts may make spoken-word recognition harder for both groups of children, but not more so for those with HL
  - possibly due to low participant numbers in HL group

Future plans:
- Collect more data once face-to-face testing is possible again
- Examine effect of hearing device type
- Re-analyse pupil data using growth-curve analysis or curve fitting
- Analyse additional collected measures:
  - working memory (digit span)
  - vocabulary (PPVT-4)
  - speech perception (CNC word list)

References

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Acknowledgements

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