Real-time language comprehension in American Sign Language (ASL)

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Why study real-time ASL comprehension?
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- Which aspects of language acquisition are universal across spoken and signed languages and which are modality-dependent?
  - E.g., Goldin-Meadow (1997) or Newport (1990)
Why study real-time ASL comprehension?

- 1-6 out of every 1,000 newborns are born with congenital hearing loss
- These children are at risk of underperforming in language and literacy
- Important to have evidence of what the natural acquisition of sign language looks like
Looking-while-Listening procedure

- **Accuracy**: the proportion of time looking at the target picture out of the total time looking at either picture during response window.

- **Reaction Time (RT)**: the latency of the first shift to the target picture after the target noun begins.

Fernald, et al. 1998; 2008
Time course analyses of eye movement data at 18, 24, & 36 months

Children become faster and more accurate in online word recognition over the 2nd & 3rd years

Proportion fixation to target picture

Where's the D O G G Y

Zangl & Fernald (2006)
Continuity into school age...

Language processing efficiency at 25 months predicts performance on standardized tests of IQ and working memory at 3rd grade

25 months

8 years

Marchman & Fernald (2008)
ASL processing research

- **Parallels**
  - signers sensitive to sub-lexical features during real-time comprehension
  - signers are influenced by both lexicality and frequency

- **Differences**
  - sign identification required less of the signal than spoken word identification

(Corina & Emmorey, 1993; Carreiras et al., 2008; Emmorey & Corina, 1990)
ASL lexical development

- **Parallels**
  - produce signs by end of the first year and two-sign sentences by their 2nd birthday
  - young ASL learners tend first to learn more nouns than verbs or other predicates

- **Differences**
  - ASL learners make more frequent shifts in gaze to their caregiver
  - Deaf caregivers alter signs to support children’s visual learning

(Anderson & Reilly, 2002; Lieberman, Hatrak, & Mayberry, 2014; Newport & Meier, 1985)
Research questions

- Do ASL processing skills follow a similar developmental trajectory as spoken language?

- Does auditory experience change the time-course of children’s lexical access in ASL?

- Are the dynamics of establishing reference different for ASL compared to spoken language?
How to adapt the LWL procedure to measure real-time processing in children learning ASL?
Visual Language Processing (VLP) task
Linguistic stimulus #1

- **Sentence-initial** question: “WHERE [target noun]?”
Linguistic stimulus

- **Sentence-final** question: “HEY! [target noun] WHERE?”

[Video link]
Trial structure in the VLP task

Signer on

Carrier phrase onset

Target noun onset

Question sign onset

Encouragement

Signer off

Images appear for two seconds prior to signer appearing

Signer holds question sign for two seconds to give child time to look at the images
Visual stimuli

- Four yoked pairs of eight target nouns
- Familiar to most children in target age range
- Minimal phonological overlap
Defining the “start” of a sign
Study overview

- 29 children
  - Ages: 18-54 months
  - Median Age: 27 months
  - 16 Deaf signers, 13 hearing signers (CODAs)
  - All children were native learners of ASL

- 19 fluent adult signers

Measures
- Real-time ASL processing
- Parent report of ASL vocabulary size
ASL processing measures

- **Window Accuracy**: mean proportion looking to the target picture out of the total time spent looking at the signer, the target picture, or the distractor picture.

- **First shift accuracy**: proportion of initial shifts off the central signer to the target picture vs. distractor picture.

- **Reaction Time (RT)**: latency to leave the signer on shifts to the target picture.
Does the development of processing skills in ASL follow a similar developmental trajectory as children learning spoken language?
Overview of the time-course of looking behavior for younger children, older children, and adults
Group-level measures of developmental change in language processing skills
Children who were more accurate and responded faster had larger productive sign vocabularies

$r = .45$

$r = .6$
Exploratory analysis of Deaf signers’ and hearing signers’ real-time ASL processing

- Deaf signers
  - 16 children
  - *Mean age* = 28 mos

- Hearing signers (CODAs)
  - 13 children
  - *Mean age* = 29 mos
Does real-time ASL processing look different for Deaf signers vs. hearing signers (CODAs)?
Similar time-course of looking behavior for Deaf and hearing children learning ASL
Similar Window Accuracy and RT, but Deaf signers were more accurate with their first shifts.
Participant and task information

- Native ASL-learning children
  - 18-26 mos
  - $n = 19$

- Native English-learning children
  - 24-26 mos
  - $n = 23$
English-learners’ first shifts were more likely to be incorrect and they shifted faster.
Takeaway points:

- ASL learners’ processing skills follow similar developmental trajectory as children learning spoken language.

- Children with better ASL processing skills also have larger ASL vocabularies.

- ASL processing skills are driven by experience with a visual language, and not by deafness.

- Preliminary evidence that ASL learners wait longer to shift, resulting in better accuracy.
Ongoing work

- Collecting an age-matched sample of hearing English learners on the 3-AFC task

- Coding mother-child interactions for features of the input that might predict better language skills.
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