Bottom-up and Top-down Competition in Sentence Processing by Children

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INTRODUCTION

Efficient sentence processing relies on both bottom-up, sound-to-word mapping and top-down linguistic associations/constraints.

The brother draws the small picture

Lexical processing

• Acoustic information unfolds over time, with similar-sounding candidates competing until one word wins.1
• This process becomes more efficient across development, from infancy to adolescence. Increases in efficiency involve faster activation of target and better suppression of similar-sounding competitors.1,5

Interplay of top-down and bottom-up

• Children as young as 2 years old use semantic information from one word (e.g., the verb) to facilitate access of later words (thematic objects).3
• When adults hear a semantically informative verb, they no longer consider phonological competitors of the target word.4

OUR QUESTION: What is the role of development?

• Does this immediate integration rely on efficient, adult-like lexical processing?
• Do children show similar use of semantic facilitation to bypass phonological competitors?
• Does this ability differ with age and/or vocabulary size?
• Specifically, we investigated whether there were differences in sentence processing across two ages: 5-year-olds and 10-year-olds.
• This age range spans a period of lexical processing development characterized by more efficient target activation and suppression of competitors.

Hypotheses

• Looks to target: lexical access
  • All children will show more and faster looks to the target word (picture) after hearing a semantically informative verb (draws) in comparison to an uninformative one (grabs).
• Looks to cohort competitor: lexical competition
  • All children will show phonological competition during recognition of the target word after hearing a neutral verb.
  • Younger children will show less efficient suppression of this competition.
• All children will show suppression of phonological competition in the informative condition.
  • Younger children will show less efficient suppression of this competition, even with an informative cue.

METHODS

Participants: 5-year-old (N = 14) and 10-year-old (N = 19) typically developing children

Task: Looks to picture referents during sentence listening measured with Visual World Paradigm
• Participants listen to a sentence and are shown a pointer to touch the picture that matches the final target word on a touchscreen monitor.
• Eye movements to each picture reflect which words are being considered across time.

Measuring the effect of available semantic information on lexical access:
• Two sentence types: Informative and Neutral
• Four picture referents on screen: target, cohort, and two unrelated distractors

RESULTS

Target Looks: Lexical access
• Older children show faster looks to target in the neutral condition compared to younger children, but there is no difference between the age groups in the informative condition.
• All children show more and faster lexical access after hearing a semantically-informative verb in comparison to a neutral one.
• Age group does not predict this semantic facilitation of lexical access.

Cohort Looks: Lexical competition
• Older children show faster suppression of cohort competition in the neutral condition compared to younger children, but there is no difference between the age groups in the informative condition.
• All children bypass phonological competition in the informative condition, regardless of age-related differences in lexical competition in the neutral condition.

CONCLUSIONS

Our question: What is the role of development?
• Similar to adults, children immediately integrate semantic information from the verb to facilitate access and bypass lexical competition during recognition of upcoming words.
• This semantic facilitation of word recognition remains stable across the school years (5- to 10-year-olds).
• This suggests this component of sentence processing is well-developed prior to 5-year-olds.
• Reductions in age-related differences in lexical processing, school-aged children recognize words with similar efficiency when a semantic cue is available to facilitate lexical access and bypass lexical competition.

FUTURE DIRECTIONS

Developmental perspective
• Identification of vocabulary measures in the model will allow us to ask questions about the role of vocabulary in the ability to integrate top-down and bottom-up information during sentence processing.
• Use of a similar paradigm with younger children will help to determine whether this language processing ability shows development earlier in childhood.
Clinical perspective
• Upcoming work from our lab suggests children with cochlear implants, who have difficulty with word recognition, show facilitation of lexical access given a semantic cue, but do not fully suppress phonological competition.
• Children with Specific Language Impairment demonstrate different integration of top-down semantic information, but we have yet to see how this interacts with bottom-up phonological competition.