Learning Structural Biases of Novel Verbs: An ERP Study

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Introduction

One powerful guide to incremental language processing is verb bias, knowledge about the likelihood that a certain sentence structure co-occurs with a particular verb.

- Adults are sensitive to verb bias, measured behaviorally [1, 2, 3] and neurophysiologically [4, 5].
- Longer reading time and larger P600 at would, because warn is likely to be followed by a direct object, rather than a sentential complement.
- “Tickle the frog with the feather” in an ambiguous visual world context, which contains both a frog holding a small feather and a big feather.
- More fixations to target instrument at feather, because tickle is an instrument-biased verb.
- Young infants, children, and adults exploit statistical information at multiple linguistic levels [6, 7]. For verb learning in particular, linguistic distributional information supports both verb-general and verb-specific constraint learning [8, 9].

Questions

- Is adults’ learning of novel verb bias dependent on structural-related or semantic-related distribution?
- What is the electrophysiological process underlying verb bias learning?

Design

Materials

- 4 novel verbs: dak, glim, norge, veeb.
- 4 sentence types: Attachment (2) X Ambiguity (2)
- 2 study sessions: Block 1 & 2
- 16 sentences per verb bias condition

Attachment | Ambiguous | Unambiguous
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Instrument | Verb + DO + with PP | Verb + DO + using
Modifier | Verb + DO + with PP | Verb + DO + that has

Stimulus Examples

Instrument-Ambiguous / Instrument-Unambiguous:
The suntanned farmer dakked the corn with / using the big tractor as soon as he needed to harvest the crop.

Modifier-Ambiguous / Modifier-Unambiguous:
The suntanned farmer dakked the corn with / that has the high stalks as soon as he needed to use the tractor.

Participants

- 32 adults (18-22 years old; English native speakers; 16 females and 16 males)

Procedure

- Picture Viewing
- Sentence Reading SOA = 500 ms

Results – Learning the Verbs

Results – Overall

- Ambiguity effect: Larger P600 in Ambiguous than in Unambiguous training.
- Attachment effect: Smaller N400 in Instrument than Modifier training.
- Attachment by Ambiguity interaction: Not reliable, though reduction of N400 in instrument training is only reliable in Ambiguous but not Unambiguous trials.

Results – Learning the Verb Bias

- The N400 effect was reduced in the second block and was followed by the emergence of a P600 response.
- The transition from N400 to P600 across training blocks was true only for subjects whose relatives are all right-handed (RR), but not those who have at least one left-handed relative (RL).

Conclusion

- Evidence for structural bias learning about novel verbs:
  - N400 reduction in Instrument-Ambiguous training reflects the fit of the noun’s meaning with the instrument role predicted based on the newly learned verb bias. No such evidence in Unambiguous condition indicates the insufficiency of semantic info for verb bias learning.
  - Different block effects responding to verbs in Ambiguous and Unambiguous structures suggest verb-specific structural biases facilitated reader’s processing of novel verbs.
  - Right-handers with no left-handed relatives, learning verb bias involves a transition from semantic to syntactic processing.

- Experience-dependent plasticity persists in the language system, through continuous collection of statistical regularities in linguistic input.

Future Direction

- Test subjects’ explicit awareness of the trained biases
- Address when and how people use newly learned verb bias during comprehension

References

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