Parents' Response Times Provide Implicit Negative Evidence for Grammar Learning

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Abstract

A key debate in language development is how children learn an infinitely generative language from a finite amount of evidence. Although children can reasonably take the production of an utterance from an adult as evidence for its grammaticality, this positive evidence may not be sufficient to constrain the learning of an infinitely generative grammar with complex rules and numerous, subtle exceptions. The problem would be easier if children consistently received negative evidence after producing incorrect utterances. However, while parents sometimes correct children's semantic errors, they rarely correct syntactic errors. Parents' reformulations of children's utterances (e.g. "I runned yesterday" with "Yes, you ran yesterday") could be useful for learning correct grammar, but knowing when a response is a reformulation is non-trivial without knowledge that allows the two forms to be aligned. We hypothesized that children may rely on a lower-level signal in conjunction with or even instead of reformulations: response time. We analyzed response times from three dense corpora to examine how parent response times vary with the grammaticality of the child utterance. This analysis revealed that parents were significantly slower to respond to ungrammatical utterances than grammatical utterances. These results indicate that response time may be one implicit learning cue for language. Additionally, we employed a self-paced reading experiment and found that adults are significantly slower to process overregularized utterances compared to their grammatical counterparts, indicating that parents may take longer to respond due to a processing delay.

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By the time children begin attending school, they successfully employ language every day to communicate, cooperate, and learn with each other and adults. This growth from a prelinguistic infant into a fluent language user in so few years is remarkable given the complexity of early language input and relative lack of direct instructions in the grammar rules of language. How might children learn to become competent grammar users? Children receive a large quantity of positive evidence – information about what is correct to say – in their language environments (Ambridge & Lieven, 2011, chapter 6). Since children are generally surrounded by many competent language users, they can reasonably take any adult-produced utterance as evidence for its grammaticality. Although positive evidence does not consist of direct instruction, children are able to employ their excellent statistical reasoning to draw conclusions about language from this type of evidence. In unsupervised learning, only positive evidence is available to the learner. That is, if kids learn grammar in an unsupervised learning environment, they must be able to generate rules about grammar only from the grammatical utterances they receive in their linguistic environment. Such a task is not infeasible - in fact, prelinguistic infants are quite capable of learning in an unsupervised context. A major hurdle in language learning is identifying word boundaries from a speech stream. Infants are constrained to the use of positive evidence to overcome this hurdle but succeed nonetheless. Saffran, Aslin, and Newport (1996) found that "a fundamental task of language acquisition, segmentation of words from fluent speech, can be accomplished by 8-month-old infants based solely on the statistical relationships between neighboring speech sounds." Statistical reasoning of this kind is not limited only to prior experience; infants are also able to generate rules from distributions of language input and apply those rules to novel stimuli, making this ability key for learning language for which there are uncountably many correct but unheard utterances (Aslin & Newport, 2012; Berko, 1958). Sometimes, however, the rules that infants generate from positive evidence are incorrect or insufficient. It would certainly be helpful if these infants could get feedback

when their rules fail, i.e., when they produce ungrammatical utterances. This negative evidence about what is incorrect to produce could greatly simplify the grammar learning problem by providing correction. If children also receive feedback when they produce something ungrammatical, they would learn grammar through supervised learning, i.e., learning in which the learner receives both positive and negative evidence. Some aspects of language learning, namely category labelling, occur in a supervised context. If a child makes a semantic error by labelling a horse as "dog," parents are likely to respond with correction - "that's not a dog, that's a horse" (Newport, Gleitman, & Gleitman, 1977). Are infants learning grammar, like vocabulary, in a supervised context or is their input set constrained to positive evidence? If infants learn grammar in a supervised learning context, one might expect explicit parent corrections in response to ungrammatical utterances. However, while parents are likely to correct semantic errors, they are much less likely to correct syntactic errors (Newport et al., 1977). Since children do not receive reliable, explicit negative feedback, do they learn grammar in a completely unsupervised manner? Perhaps children are able to make corrections to their inaccurate understanding of grammar through continued exposure to positive evidence or through innate or environmental constraints (see Bowerman, 1988). Another possibility is that children do receive some negative evidence but such evidence is less explicit than the typical semantic correction. While parents are unlikely to specifically correct their child's ungrammatical utterance, they will occasionally reformulate the utterance by repeating the content of the child's utterance in a grammatical structure (Hirsh-Pasek, Treiman, & Schneiderman, 1984; Chouinard & Clark, 2003). For example, a child might produce "I catched the ball" and her father might respond, "Yeah, you caught the ball yesterday at tee-ball practice." However, while adults sometimes reformulate child utterances, they do so infrequently. Not only is this an unreliable signal for the child but reformulations are a significant challenge to draw negative information from (Marcus, 1993; Morgan & Travis, 1989). Prior work has found that adults are slower to process an unpredicted utterance (Jurafsky, 1999; Fine & Jaeger, 2013). Given this work, we

investigate the possibility that parents may take longer to process their child's unexpected (i.e., ungrammatical) utterances and thus respond later to their child's utterance. If parents demonstrate a delay in response to a child's overregularized utterance, the delay may provide an implicit cue to the child that they produced an incorrect utterance. We propose and investigate a novel form of negative evidence for grammar learning - parent response time.

Methods

We report how we determined our sample size, all data exclusions (if any), all manipulations, and all measures in the study.

Participants

Material

Procedure

Data analysis

Results

Discussion

98 **References**