Effects of linguistic cues in learning verbs and nouns: A computational study of early word learning
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It has been suggested that children draw on syntactic cues that the linguistic context provides in verb learning, a hypothesis known as syntactic bootstrapping (Gleitman, 1990). In contrast, the acquisition of nouns seems to be more dependent on cross-situational context and the regularities therein. According to the syntactic bootstrapping view, verbs are learned with a delay because the linguistic information that supports their acquisition is not available during the early stages of language acquisition. To investigate the impact of linguistic and extralinguistic cues in identifying words, Gillette et al. (1999) proposed the Human Simulation Paradigm (HSP): adult participants are asked to identify target words by watching videos, provided with different degrees of information about the linguistic context of the target verbs. Various studies of this type have shown that linguistic and structural cues significantly improve the performance of adults in identifying verbs. Piccin & Waxman (2007) showed the same trend for school-age children, but their performance is inferior to adults. These findings hint at a gradual development of syntactic bootstrapping, but it is uncertain whether the same effect can be observed in much younger children who have not mastered the syntactic structure of their language yet.

We propose a novel approach to studying this problem. We use a Bayesian model of early verb learning which incrementally learns syntactic constructions of language via clustering similar verb usages. We simulate the task of identifying target words in novel situations as finding the word with the highest conditional probability given different sets of (perceptual and linguistic) cues. We train our model on a set of scene-utterance pairs before evaluating it on a word identification task. In the “no linguistic information” (-LI) condition, only the properties of the event and the conceptual and event-based properties of the participants are included. In the “with linguistic information” (+LI) condition, the syntactic properties of the accompanying utterance are also given. The age of the model is determined by its exposure to input data prior to performing the task. We simulate different age groups by varying the size of the training data.

The results of our computational simulations replicate the experimental findings of Piccin & Waxman (2007) that syntactic information boosts the identification of verbs by adults (Figure 1, top left). Our results also suggest that the boosting effect comes into play with a delay, and only after enough input data is processed and a relatively stable knowledge of syntactic constructions are formed. Specifically, our model predicts that very young children's verb learning might not be modulated by linguistic information (Figure 1, top right), even though a significant impact can be found in the later stages of development. Also, guessing nouns for the younger age groups was less accurate when the linguistic information was provided, and no effect on performance by linguistic information was observed in later age groups (Figure 1, bottom panel). This might be due to the fact that most early nouns refer to observable concepts, and are less dependent on the structure of their linguistic context than verbs.
Figure 1: Average absolute accuracy of identifying verbs (top panel) and nouns (bottom panel) in early stages of learning for different age groups: after processing 500 input pairs (left) or 100 input pairs (right). The dashed lines and the solid lines represent the “no linguistic information” (-LI) and “with linguistic information” (+LI) conditions, respectively.

References:

