

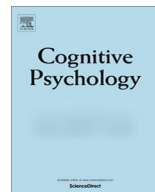


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Revise and resubmit: How real-time parsing limitations influence grammar acquisition



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ABSTRACT

We present the results from a three-day artificial language learning study on adults. The study examined whether sentence-parsing limitations, in particular, difficulties revising initial syntactic/semantic commitments during comprehension, shape learners' ability to acquire a language. Findings show that both comprehension and production of morphology pertaining to sentence argument structure are delayed when this morphology consistently appears at the end, rather than at the beginning, of sentences in otherwise identical grammatical systems. This suggests that real-time processing constraints impact acquisition; morphological cues that tend to *guide* linguistic analyses are easier to learn than cues that *revise* these analyses. Parallel performance in production and comprehension indicates that parsing constraints affect grammatical acquisition, not just real-time commitments. Properties of the linguistic system (e.g., ordering of cues within a sentence) interact with the properties of the cognitive system (cognitive control and conflict-resolution abilities) and together affect language acquisition.

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1. Introduction

In order to interpret spoken language, listeners must assign provisional structural analyses to utterances in real-time as they hear them; that is, they must rapidly categorize unfolding sound

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events into candidate phonemes, syllables, words, and phrases, through some kind of language parsing mechanism. Yet, for those learning a language, be they a child learning their first language, or an adult learning additional languages, language-specific rules of categorization are partially or completely unknown, even though these rules are the very same ones that ultimately permit successful interpretation. This picture is further complicated by the fact that learners' provisional structural assignments are not used solely for the purposes of interpretation, but also as input to the learning procedure itself. For instance, it is now well established that young children learning their first language – and adults learning a second language – will use their hypothesis about the syntactic structure of a sentence to constrain hypotheses about the meanings of unknown words and unknown morphemes within that sentence, in a process known as 'syntactic bootstrapping' (e.g., Gillette, Gleitman, Gleitman, & Lederer, 1999; Gleitman, 1990; Gleitman, Cassidy, Nappa, Papafragou, & Trueswell, 2005; Landau & Gleitman, 1985; Naigles, 1990; Snedeker & Gleitman, 2004).

It seems then that the structure building mechanism itself (i.e., the real-time parser) would play a central role in the progression of language acquisition. Yet, relatively little is known about how the challenges and limitations of real-time parsing in language learners, such as their documented difficulty revising parses (e.g., Trueswell, Sekerina, Hill, & Logrip, 1999), shape acquisition trajectories, nor how the parsing process itself gets 'off the ground' in the first place in the absence of language-specific grammatical knowledge. Below we begin to explore these two interlocking issues. We assert that at the start of the learning process, the mapping of utterances onto meaning is guided by universal biases, which are gradually accompanied or supplanted by language-specific grammatical knowledge that guides parsing and interpretation more accurately (for related views in the first language acquisition literature see Fisher, Gertner, Scott, & Yuan, 2010; Gertner & Fisher, 2012; Gleitman et al., 2005; Lidz, Gleitman, & Gleitman, 2003; for second language acquisition, see Van Patten, 1996). We explore here a novel hypothesis within this view, that the transition from universal biases to the use of language-specific knowledge is shaped not only by the validity and reliability of language-specific cues to structure and meaning (Bates & MacWhinney, 1982, 1989; MacWhinney, Bates, & Kliegl, 1984; Slobin & Bever, 1982), but also by inherent challenges associated with the real-time incremental nature of sentence processing itself, such as the difficulty of revising initial structural analyses and interpretations.¹

1.1. Parsability and learnability

According to the theory of syntactic bootstrapping, children discover the meanings of words not just by observing the world and keeping track of world-word contingencies, but also by taking advantage of the linguistic contexts in which words appear (Gleitman, 1990; Landau & Gleitman, 1985). Children's ability to use linguistic context during word learning is apparent early in development. For example, in her classic first studies of the learning effects of implicit syntactic analyses, Naigles (1990) showed that 25-month-olds infer aspects of a new verb's meaning from the syntactic context in which the verb appeared. Exposing children to a novel verb in a transitive sentence ("The duck is glorping the bunny") led children to believe that the novel predicate denoted a two-participant causal event rather than a one-participant non-causal event. Hearing a novel verb in an intransitive sentence ("The duck and the bunny are glorping") generated the opposite preference, indicating that children understood the novel predicate to denote a one-participant non-causal event. Numerous studies have since demonstrated similar syntactic effects on verb learning (e.g., Arunachalam & Waxman, 2010; Fisher, Hall, Rakowitz, & Gleitman, 1994; Lee & Naigles, 2008; Nappa, Wessell, McEldoon, Gleitman, & Trueswell, 2009; Scott & Fisher, 2009; Yuan & Fisher, 2009; Yuan, Fisher, & Snedeker, 2012), and similar use of linguistic evidence has been observed for the learning of nouns (e.g., Brown, 1957;

¹ This hypothesis is indebted to related views in the literature, most notably Bever (1970)'s seminal theorizing on the influence of perceptual strategies on the acquisition and representation of language. Moreover, interactions between processing and acquisition could have implications for language change and the types of natural language grammars expected to be observed in the world (see, Bever & Langendoen, 1972, and more recently, Hawkins, 2004, 2012, 2014); these views are compatible and partially overlapping with our present proposal (see Section 3).

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