

Chapter 25

Two Distinct Sequence Learning Mechanisms for Syntax Acquisition and Word Learning

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ABSTRACT

The ability to acquire spoken language depends in part on a sensitivity to the sequential regularities contained within linguistic input. In this chapter, the authors propose that language learning operates via two distinct sequence-learning processes: probabilistic sequence learning, which supports the acquisition of syntax and other structured linguistic patterns, and repetition sequence learning, which supports word learning. First, the authors review work from their lab and others illustrating that performance on tasks that require participants to learn non-linguistic sequential patterns is empirically associated with different measures of language processing. Second, they present recent work from their lab specifically highlighting the role played by probabilistic sequence learning for acquiring syntax in a sample of deaf and hard-of-hearing children. Finally, the authors demonstrate that the learning of repeating sequences is related to vocabulary development in these children. These findings suggest that there may be at least two relatively distinct domain-general sequential processing skills, with each supporting a different aspect of language acquisition.

INTRODUCTION

How infants learn language is one of the great scientific questions of our time. While traditional nativist views of language development rely on predetermined, innate modules to explain the infant's ability to acquire complex language systems in a short amount of time, learning perspectives

have more recently turned to domain-general processes to explain this phenomenon. As it turns out, there is evidence that infants have an uncanny ability to encode structure in complex stimulus patterns through the use of domain-general, statistical learning mechanisms. Although the idea that statistical information could be used to help decode and segment speech is at least several

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decades old (Harris, 1955), it was the pioneering study by Saffran, Aslin, and Newport (1996) that empirically demonstrated that, in fact, infants can use co-occurrence statistics to parse novel words from sequences of nonsense syllables. This finding has opened the door for more nuanced discussions of the nature of domain-general learning abilities and their role in language acquisition.

There is now considerable agreement that statistical learning processes (also known as distributional learning, implicit learning, sequential learning, procedural learning) are crucial to language acquisition (Conway & Pisoni, 2008; Kuhl, 2004; Reber, 1967; Saffran, 2003). However, most of the empirical work has focused on what could be referred to as “existence proofs”: Many organisms, including human infants, children, and adults (as well as some non-human animals and artificial neural networks) appear to have the capability for encoding the statistical structure contained within input sequences. However, it is an altogether separate question as to whether these organisms actually use these learning abilities in the service of language acquisition. A notable advance in this regard has been made by several recent studies that have empirically demonstrated that, in fact, such domain-general learning abilities are associated with aspects of language use (Arciuli & Simpson, 2012; Conway, Bauerschmit, Huang, & Pisoni, 2010; Misyak, Christiansen, & Tomblin, 2010). Despite (or perhaps, because of) these recent studies showing that domain-general learning mechanisms are associated with language processing, a second set of questions emerge. Are statistical/sequential learning mechanisms used for all aspects of language acquisition (i.e., phonology, syntax, word learning, etc.)? In addition, related to this question, might there perhaps be more than one learning mechanisms that the infant brings forth to learn different aspects of language?

In this chapter, we describe some initial evidence to suggest that the answer to these questions is “yes”; that there may be distinct, domain-general learning mechanisms that are used to learn dif-

ferent aspects of language. Below, we begin by presenting some theoretical considerations relating to these learning mechanisms. We then present three lines of empirical research exploring the connection between domain-general sequence learning and language skills: In the first line of research, we review behavioral and neurophysiological findings with healthy adults showing that sequential learning allows the learner to encode the structure inherent in language, which provides the means for making implicit predictions about what linguistic units will be spoken next. In the second line of research, we provide some evidence focusing on deaf and hard of hearing children, suggesting that syntax acquisition may be mediated by probabilistic (or statistical) sequence learning mechanisms. Finally, in the third line of research, we highlight recent work with this same population suggesting that word learning may be mediated by mechanisms related to repetition (or fixed or invariant) sequence learning. It should be noted that while the data presented in the chapter is cross-sectional in nature, we use the terms “language acquisition” and “language development” to express our theoretical viewpoint that these domain-general learning mechanisms causally affect language acquisition, rather than the two abilities merely co-existing independently.

BACKGROUND

Any discussion of spoken language acquisition requires consideration of at least two cognitive processes: auditory processing and serial order processing. The importance of auditory exposure to spoken language is perhaps obvious. Children learn their native language through early exposure to the language stimuli presented in their environment. For example, a robust line of work demonstrates that children can discriminate between all phonemes at birth, but lose that capability around 3 months of age, around which time their vocalizations begin to take on the particular characteristics

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