Language learning from conversations: the influence of social contexts on active learning behaviors

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Abstract

Human language learning is a striking accomplishment. How do children progress from being unable to understand or produce words to using language to communicate their goals, to ask questions, and to coordinate others' behaviors? In this paper, I propose that conversations – the fundamental language learning context – can be productively construed as opportunities for constrained self-directed learning, allowing children to shape the input to language learning mechansims. I also argue that integrating formal models of social learning with models of decision making provides a productive framework to better understand the mutual influence of these two factors on language learning. Finally, I present a conceptual analysis of children's decisions about where to allocate visual attention during language comprehension to illustrate the utility of this framework.

Keywords: language acquisition, active learning, social learning, theory

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> *Conversation provides a forum for using language. It displays language embedded in larger systems for communication and so should present children with critical material for making sense of language as they try to understand others and make themselves understood.* (Clark (2009), p. 21)

Introduction

Human language learning is a remarkable feat. Consider that children, despite possesing limited processing capabilities, develop language skills quite rapidly, building an adult vocabulary ranging betewen 50,000 to 100,000 distinct words (P. Bloom, 2002). However, even to learn the meaning of a concrete noun, children must solve a variety of complex learning problems, such as segmenting discrete words from continuous speech stream (Saffran, Aslin, & Newport, 1996), reducing referential uncertainty to link words to concepts (Quine, 1960), and making the appropriate generalizations to new contexts (Xu & Tenenbaum, 2007). What makes this process even more impressive is that children must accomplish all of this using input that can be noisy, transient, and unfolds rapidly in time. How do children do it?

Fortunately, young language learners do not have to solve these problems on their own since the majority of input to language learning mechansims comes from *conversations* with more knowledable others. Social-pragmatic theories of language acquisition have emphasized the importance of these social interactions for reducing the difficulty of various language learning challenges (P. Bloom, 2002; Clark, 2009; Hollich et al., 2000). Moreover, recent modeling work has formalized the role of social reasoning processes (e.g., thinking about others' goals) in word/concept learning (Frank &

Goodman, 2014; Shafto, Goodman, & Frank, 2012) and infant-directed speech (Eaves Jr, Feldman, Griffiths, & Shafto, 2016).

However, social partners are just one of the forces that can shape the input to children's language learning mechansims. Another important factor is the choices that children make. That is, children are not just passive recipients of language; instead, they can select behaviors (e.g., ask questions) that modulate the content, pacing, and sequence of information during conversation. Recent empirical work across a variety of domains has begun to explore the effects of self-directed choice on learning outcomes, showing that additional control can lead to speedier and more robust learning compared to more passive contexts (Castro et al., 2009; Markant & Gureckis, 2014; Settles, 2012).

One important challenge for the field of language aquisition is to precisely characterize the interactions between fundamentally social learning contexts, social reasoning, and children's developing ability to exert control over their environments. In this paper, I argue that learning from conversation can be productively construed as providing rich opportunities for *constrained active learning*. The key insight is that the presence of other people qualitatively changes the cost/benefit calculus for learners' choices, which in turn shapes subsequent input to language leanring mechanisms. The plan for the paper is as follows. I first review evidence that supports the importance of social contexts for language learning, integrating ideas from formal models of social learning. In part II, I connect the social learning ideas with research on formal models of decision making that emphasize the utility structure of different actions available to the learner. I present a conceptual utility analysis of a wide variety of behaviors available to the developing language learner. I end by introducing a case study – the allocation of visual attention to gather information for language comprehension – to illustrate the usefulness of this framework for understanding the joint effects of social

and self-directed learning processes on language acquisition.

Part 1: Language learning is a social process

Language learning as social interaction

Formal models of learning from others

Social learning is the accumulation of knowledge based on the sampling decisions of other agents (e.g., via the framework in Shafto et al., 2012). Requires reasoning about why the other agent made the choices they did.

Why is social learning so powerful?

Different models of social learning

Examples: * Sobel and Kirkham * observational learning * pedagogical inference * social as attention vs. social as changing underlying inferences because of reasoning about others minds

What is missing from the social learning account?

Models of seeking information from social targets: * Baldwin & Moses (1998): The Ontogeny of Social Information gathering * Chouinard (2007): Children's questions as learning mechanism

Part 2: Active learning as rational decision making

Classic theories of development have shared the intuition that knowledge acquisition is a fundamentally active process, with the learner playing an important role in shaping the learning environment (Bruner, Piaget, Vygotsky). And recent theoretical and empirical work has formalized these ideas by characterizing development as a

process of active hypothesis testing and theory revision that can be described by principles of Bayesian reasoning (Gopnik; Schulz, 2007).

Moreover, the potential benefits of active learning have been the focus of empirical work from a broad set of research areas, including fields such as education (Grabinger & Dunlap, 1995), machine learning (Settles, 2012), and cognitive science (Castro et al., 2009). Across these different literatures, the term "active learning" has been used to mean a variety of behaviors such as question asking (cite), increased physical activity (cite), or active memory retrieval (cite).

In this paper, I focus on a specific subset of active learning behaviors: the *decisions* that people make, or could make, during learning. That is, the capacity to exert control over the learning experience, including the selection, sequencing, or pacing of new information.

Markant et al. (2016) describe the benefits as "enhanced memory may be a common outcome of active learning that can arise from a number of distinct mechanisms, depending on the kinds of control afforded by an instructional activity"

Examples: * Encoding of Distinctive Sensorimotor Associations * Elaborative Encoding Through Goal-Directed Search and Planning * Co-ordination of Selective Attention and Memory Encoding * Adaptive Selection of Material * Enhanced Memory Due to Metacognitive Monitoring

Focusing of learners' choices is beneficial since there is a rich literature that has formalized decision making process, which can be used to describe choices made during learning.

Active learning as decision making

Active learning takes into account a utility structure that can include both the costs of data acquisition and the rewards of choosing an example (e.g., in terms of information acquisition/uncertainty reduction relative to some longer term learning goal).

Process: 1) analyze costs and benefits of behavior 2) planning models that take into account long-term value 3) decisions in the brain and in non-human primates

What is missing from the active learning account?

The presence of another agent can change the cost/benefit structure of choices made for learning and therefore we must include this information in our models of self-directed learning, which often view the learner as moving back and forth between active exploration and passive reception. This type of active learning account does not leave room for social reasoning processes (i.e., native utility calculus stuff) to change the value of an active learning behavior.

Part 3: Active information gathering via visual fixations to understand language

Conclusion

Models of self-directed learning cannot continue to ignore the social-communicative context in which learning often occurs. Reasoning/inferences about other people should modulate the choices that learners make: whether it's who to talk to, what to attend to, or what questions to ask.

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