Children's social learning is active: how social contexts shape learners' choices

Kyle MacDonald

Department of Psychology, Stanford University

Abstract

Children's rapid conceptual development is one of the more remarkable features of human cognition. How do they learn so much so quickly? Social learning theories argue for the importance of learning from more knowledgeable others. In contrast, active learning accounts focus on children's learning via their self-directed selection and testing of hypotheses. In this paper, I argue that an important step towards a complete theory of human learning is to understand how active learning behaviors unfold within fundamentally social learning contexts. To integrate the two accounts, I use the framework of rational decision making that emphasizes the role of utility (i.e., costs and benefits of an action) for explaining choice behavior. The key insight is that social learning is not separate from active learning, and the costs/benefits of children' decisions about what to do are shaped by interactions with other people.

Keywords: human learning, active learning, social learning, decision making, theory

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Introduction

Human learning is remarkable. Consider that children, despite striking limitations in their general processing capabilities, are able to acquire new concepts at a high rate eventually reaching an adult vocabulary ranging between 50,000 to 100,000 words. And they do this while also developing motor skills, learning social norms, and building causal knowledge. What sorts of processes can account for children's prodigious learning abilities?

Social learning theories offer a solution by pointing out that children do not solve these problems on their own. And although they learn a great deal from observation, children are typically surrounded by parents, other knowledgeable adults, or older peers – all of whom likely know more than they do. These "social" learning contexts can bootstrap learning via several mechanisms. For example, work on early language learning shows that social partners provide input that is tuned to the child's cognitive abilities (Eaves Jr, Feldman, Griffiths, & Shafto, 2016; Fernald & Kuhl, 1987), guide children's attention to the important features in the world (Yu & Ballard, 2007), and increase levels of arousal and sustained attention (P. K. Kuhl, 2007; Yu & Smith, 2016).

Social learning contexts can also change the computations that support children' learning from evidence. Recent work on both concept learning and causal learning suggest that the presence of another person engages social reasoning processes about *why* people perform certain actions. The key insight is that knowledge of the underlying process that generates information allows learners to make more appropriate inferences to facilitate learning (Bonawitz & Shafto, 2016; Frank, Goodman, & Tenenbaum, 2009).

For example, people will draw different inferences from the same observations depending on whether they think that the cause accidental or intentional behavior. Moreover, adults and children will make even stronger inferences if they think an action was intentional and selected to help them learn (i.e., teaching) (Shafto, Goodman, & Frank, 2012).

However, children are not just passive recipients of information – from people or from the world. Instead, children can actively select behaviors (e.g., ask questions, choose where to allocate visual attention) that modulate the content, pacing, and sequence of information they receive. In fact, recent theorizing and empirical work in cognitive development conceptualize early learning as an active process of exploration and hypothesis testing similar to the scientific method (Gopnik, Meltzoff, & Kuhl, 1999; Schulz, 2012). Moreover, recent empirical work across a variety of domains (education, machine learning, and cognitive science) has begun to explore the benefits of self-directed choice for speeding learning outcomes compared to passive learning contexts (Castro et al., 2009; Markant & Gureckis, 2014; Settles, 2012).

Thus, both social and active contexts can facilitate learning by activating distinct learning processes and by providing the learner with better information. But real-world learning involves a complex mixture of these processes. Thus, one important challenge for understanding the power of human learning is to precisely characterize the mutual influence of social learning contexts and children's developing ability to exert control over their environment. In this paper, I argue that learning from social contexts can be productively construed as providing opportunities for *constrained active learning*. The key insight is that the presence of other people can qualitatively change the cost-benefit calculus of learners' choices, which in turn shapes both children's input and the social context.

The plan for the paper is as follows. I first review evidence of the effects of social learning across a variety of learning domains. I also present three different mechanisms through which social contexts facilitate learning: informational, attentional, and inferential. In part II, I discuss work on active learning that explores the influence of giving people control over the learning environment. In part III, I integrate the social and active learning accounts using ideas from formal models of decision-making that emphasize the utility structure of different actions available to the learner. I conclude by presenting a conceptual analysis that explores the utility of a variety of choice behaviors available to young learners in real-world social learning contexts.

Part I: 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 beneficial?

Three mechs: 1) Better arousal/attention, 2) Better information, 3) More appropriate inferences. Some information can only be accessed via interactions with other people (e.g., language)

Different models of social learning

Examples:

- Sobel and Kirkham
- observational learning
- imitation learning

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-  pedagogical inference
-  social as attention vs. social as changing underlying inferences because of reas
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What is missing from the social learning account?

TODO: Still need to figure out exactly what I want to say here. But I'm thinking it will be something like "emphasize the teacher's model of the learner's goals and potential decision-making processes, i.e., behavior selection."

Models of seeking information from social targets:

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-  Baldwin & Moses (1998): The Ontogeny of Social Information gathering
-  Chouinard (2007): Children's questions as learning mechanism
-  Hyo's and Liz Bonawitz's work
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Part II: Self-directed learning

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.

Why is active learning beneficial?

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:

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* 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
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Focusing on *choices* is useful since there is a rich literature that has formalized decision-making process, which can be used to describe behaviors made by both more knowledgeable others and by learners. The interesting question is how costs/benefits of active learning behaviors are altered by the social context and how reasoning about learners as active might change the social context.

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, goal reasoning) to change the utility of active learning behaviors.

Part III: Integrating social and active learning via rational 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:

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- analyze costs and benefits of behavior
- planning models that take into account long-term value
- decisions in the brain and in non-human primates
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Conclusion

Models of self-directed learning should include information the social-communicative context in which learning often occurs. Reasoning about other people modulate the choices that learners make: whether it's who to talk to, what to look at, or what questions to ask.

Models of social learning should take into account the choice behaviors available to the learner. i.e., think about teaching as reasoning about another person's active learning or setting up a social learning context where the learner selects actions

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