The Developmental Origins of Selective Social Learning

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Abstract

The study of children's social learning is a topic of central importance to our understanding of human development. Learning from others allows children to acquire information efficiently; however, not all information conveyed by others is accurate or worth learning. A large body of research conducted over the past decade has shown that preschoolers learn selectively from some individuals over others. In the present article, we summarize our work and that of others on the developmental origins of selective social learning during infancy. The results of these studies indicate that infants are sensitive to a number of cues, including competence, age, and confidence, when deciding from whom to learn. We highlight the important implications of this research for our understanding of the cognitive and social skills necessary for selective learning and point out promising avenues for future research.

Social learning is defined as learning that is influenced by observation of or interaction with another individual (Box, 1984). Social learning is widespread in animals, but humans are exceptional in their reliance on information communicated by others. In fact, many of the exceptional cognitive abilities of humans are accounted for by the predominance of social learning in our species, as proposed by the cultural-intelligence hypothesis (Tomasello, 2014). However, social learning comes with potential pitfalls: The acquired information could be outdated, misleading, or inappropriate. Understanding when, how, and why individuals learn from others is critical to multiple disciplines (anthropology, economics, cultural evolution, and cognitive psychology) and has been the focus of much research over the past decade (Rendell et al., 2011). The present article explores this issue from a developmental-science perspective by showing that from an early age, children do not treat all communicated information as equally reliable but are instead selective in their allocation of trust.

Over the past decade, developmental researchers have devoted great attention to children's *selective social learning*, or propensity to learn from some sources over others (Koenig & Sabbagh, 2013; Nurmsoo, Robinson, & Butterfill, 2010). Much of this work was inspired by a landmark study by Koenig, Clément, and Harris (2004), in which 3- and 4-year-olds witnessed two adults naming various familiar objects. One individual named the objects correctly, whereas the other made blatant errors (e.g., calling a ball a "shoe"). Children later preferentially sought and accepted novel words from the previously accurate individual. Multiple subsequent studies demonstrated that children learn selectively in many situations and use a variety of cues in addition to individuals' accuracy to decide from whom to learn (see Mills, 2013, for a detailed review). The bulk of this work focused on preschool-age and older children, yet learning is obviously central to children's development long before their 3rd birthday. To better understand the importance of selective learning in children's information acquisition, it is important to study its emergence in the first few years of life. The body of work on infants' selective learning is nowhere near as extensive as that on preschoolers, yet there is growing evidence that even in their earliest years,

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infants frequently discriminate when choosing sources of information.

Infants Are Selective Learners

Human infants possess eminent social-learning abilities, as shown by their precocious ability to imitate people's actions and monitor others' attention and emotional references when uncertain about a situation. Here, we focus on infants' sensitivity to individual attributes that can signal information quality in a learning context. Infants, like older children, attend to individuals' accuracy—for instance, they show surprise when someone provides inaccurate information (e.g., Koenig & Echols, 2003). This precocious sensitivity influences infants' learning. In the verbal domain, 2-year-olds preferentially learn new labels or accept second labels for familiar objects from previously accurate rather than inaccurate speakers (Koenig & Woodward, 2010; Krogh-Jespersen & Echols, 2012). Eighteen-month-olds are less willing to imitate a novel action or learn new labels from inaccurate than accurate speakers (Brooker & Poulin-Dubois, 2013). Younger infants can use both verbal and non-verbal behaviors to infer competence. For example, 14-month-olds preferentially imitate an adult who uses familiar objects competently rather than incompetently (e.g., placing a shoe on his hand instead of his foot; Zmyj, Buttelmann, Carpenter, & Daum, 2010) and imitate the novel actions of an individual who speaks their language over a foreign-language speaker (Buttelmann, Zmyj, Daum, & Carpenter, 2013). Infants as young as 12 months seek information from "experts": After witnessing an experimenter interact with toys either competently (expert) or noncompetently (non-expert), infants attended to and interacted with a new toy more if it had been presented by the expert (Stenberg, 2013). Even infants as young as 8 months can track the reliability of potential informants: After being familiarized with faces cuing the locations of animated displays with different degrees of reliability (100% vs. 25%), infants searched longer at locations cued by the reliable face (Tummeltshammer, Wu, Sobel, & Kirkham, 2014).

Given that infants are sensitive to emotional signals from the first months of life, they have the potential to recognize inaccurate emotional signalers, or people who display emotional expressions that are incongruent with the context (e.g., an angry expression after receiving a desirable toy). Recent research based on looking time (Chiarella & Poulin-Dubois, 2014; Skerry & Spelke, 2014) and pupil-dilation measures (Hepach & Westermann, 2013) suggests that they do so by 8 months. In our laboratory, we have shown that infants as young as 14 months take into account the past reliability of an adult's affective signals when later interacting with that person. In some studies, infants were introduced to a person whose emotional signals were reliable: She showed positive facial and verbal expressions while looking inside a container, and infants subsequently found an object inside the container. In another condition, an unreliable looker also expressed positive emotions, but the container later proved to be empty. In subsequent interactions, 14- to 16-month-olds were less likely to follow the looker's gaze (Chow, Poulin-Dubois, & Lewis, 2008) and copy her action of turning on a lamp with her forehead (Poulin-Dubois, Brooker, & Polonia, 2011) if she was unreliable rather than reliable. More recently, Chiarella and Poulin-Dubois (2014) examined 18-month-olds' imitation of someone who reacted negatively to positive experiences versus someone with the expected positive reaction. Although infants subsequently imitated the simple actions of both models (e.g., shaking a rattle), they were less willing to trust the unreliable emoter when she provided guidance about the content of two containers through emotional signals.

Infants also modulate their learning based on other cues that can serve as indirect competence signals (though it is unclear how infants interpret these cues, a point we return to below). One such cue is consensus: Twenty-four-month-olds, and to a lesser extent 18-month-olds, preferentially accepted information toward which a third party indicated agreement (nodding) rather than disagreement (head shaking; Fusaro & Harris, 2013). Age may also be considered an indirect indicator of competence, as adults typically know more than children. Infants sometimes imitate selectively based on age (e.g., Ryalls, Gul, & Ryalls, 2000; Zmyj, Daum, Prinz, Nielsen, & Aschersleben, 2012). However, the direction of this effect varies: Infants sometimes imitate adults over children but in other contexts are more likely to imitate a peer. For example, 14-month-olds preferentially imitate adults when observing novel actions (e.g., turning on a light with one's head) but preferentially imitate same-age infants when the action is already in their repertoire (e.g., pulling objects apart using their hands; Zmyj et al., 2012).

Another potential competence cue is confidence. Two-year-olds preferentially imitate novel actions demonstrated by an individual showing confidence rather than uncertainty (Birch, Akmal, & Frampton, 2010). This sensitivity, however, appears to develop later than sensitivity to some other cues, as preferential imitation of confidently demonstrated actions is present at 24 months but absent at 18 months (Brosseau-Liard & Poulin-Dubois, 2014).

Outstanding Areas of Investigation

Beyond acknowledging that infants can be selective in their social learning, which the studies reviewed above

have demonstrated, much work is needed still to understand the exact nature of this ability. More specifically, the cognitive and motivational mechanisms underlying this precocious learning selectivity remain to be identified. Are these mechanisms stable, or do they change across development? Given the current state of knowledge in this field, it is premature to offer a conclusive answer to this question. However, there are some hints at the form that this answer might take, as discussed below.

A rich theoretical account of children's social learning from others' testimony has recently been proposed (Sobel & Kushnir, 2013). In a nutshell, this proposal states that children make rational inferences about the reliability of testimony based on their prior knowledge plus new evidence about the informants they interact with. To what extent do similar inferences underlie the emergence of selective social learning? It is well established that infants are active information gatherers who are adept at using observed data to guide their actions and attention. For instance, infants' sensitivity to statistical regularities and capacity for probabilistic inferences are present very early in life (Aslin & Newport, 2012; Denison & Xu, 2014), and such general learning mechanisms may explain some of the earliest manifestations of selective learning. One outstanding question is whether infants make any inferences about people's competence or knowledge, even implicitly.

In the preschooler literature, one specific cognitive mechanism has received a lot of attention: *theory of mind*, or the ability to reason about other people's mental states, such as intentions, desires, knowledge, and beliefs. Individuals' (in)accuracy could prompt children to attribute knowledge or ignorance and subsequently expect knowledgeable individuals to provide good information (and ignorant individuals bad information). Children may also make other mental-state-related inferences based on the behavior of potential informants, such as inferring that they intend to be informative or deceptive. If children are making these types of mental-state inferences, and if these inferences are driving their propensity to be selective about the information they accept, then we would expect those children with superior theory-of-mind skills to be more successful on selective-learning tasks.

A few recent studies have demonstrated associations in preschoolers between theory of mind and greater selective learning from accurate individuals (e.g., DiYanni, Nini, Rheel, & Livelli, 2012; Lucas, Lewis, Pala, Wong, & Berridge, 2013). Additionally, in a recent study (Brosseau-Liard, Penney, & Poulin-Dubois, 2015), we showed that success on a selective-learning task based on informants' prior accuracy was predicted by children's theory-of-mind skills, whereas theory of mind did not predict performance on a selective-learning task in which informants

were differentiated by an attribute that is unrelated to knowledge (specifically, physical strength). This suggests that theory of mind likely contributes to older children's abilities to selectively learn from reliable individuals.

One key question for future research: Is this also true of infants? Over the past decade, it has been proposed that infants possess precocious theory-of-mind competencies when their abilities are assessed with age-appropriate tasks (Baillargeon, Scott, & He, 2010), but infants' level of understanding is still hotly debated, and a substantial research effort is attempting to clarify this question (Ruffman, 2014). We believe that selective learning in infants and very young children likely emerges with the support of some form of understanding of humans' motivational states, such as goals and "intentions-in-action," that does not require a representational theory of mind—that is, an understanding of false belief (Sodian, 2011). For example, based on nonverbal cues such as vocalizations and gestures, infants can detect the intentional or accidental nature of an action and the unfulfilled intention behind an incomplete action (Olineck & Poulin-Dubois, 2009).

With age, children gradually integrate their initial ability for selective trust with their richer understanding of mental states and their increasing comprehension of pragmatics and communication, including the comprehension of situations that lead others to make mistaken statements, tell playful jokes, or intentionally mislead others. This likely accounts for more sophisticated and nuanced selectivity in the later preschool years. However, this account is purely speculative at this point, as there has been no research directly comparing the selective-learning performance of toddlers and preschoolers and limited investigation of the cognitive mechanisms underlying selective learning. We plan to conduct future research on these issues. Furthermore, the current literature contains disproportionate speculation regarding how children interpret individuals' accuracy; we plan to also investigate the ways in which infants and young children interpret all the other cues reviewed above—confidence, age, and expertise, to name a few.

Finally, much of the selective-learning literature, and research on imitation and learning more generally, focuses exclusively on the cognitive benefits of learning in terms of the acquisition of useful information. However, copying behaviors can also be motivated by a desire for affiliation (Over & Carpenter, 2013). With older children, one can witness selective social learning based on attributes that would seem much more relevant to a desire for affiliation than to a desire for accurate information seeking—for instance, preferring a model who displays similarity with the child (Reyes-Jaquez & Echols, 2013) or imitates the child (Over, Carpenter, Spears, & Gattis, 2013). Probing infants' motivations in attending to

different model attributes will shed light on the purpose of these biases.

Conclusions

We have reviewed substantial recent work showing that infants are selective social learners: They are remarkably sensitive to a range of model-based characteristics when deciding from whom to learn. While the laboratory-based studies that we reviewed provide clear evidence that infants possess model-based social-learning strategies, one might wonder to what extent such strategies are necessary in the real world. After all, rarely do adults intentionally call a ball a "dog" or put a sock on their hand, except playfully. Nonetheless, infants can be exposed to speakers who are not fluent in their native language; to practical jokers, liars, or absent-minded people; and to older siblings who are ignorant in many learning contexts. Sensitivity to attributes that indicate whether someone is a good or bad source of information is thus likely to have a real impact on learning, even in infancy.

Furthermore, many of the cues used in infancy are at least superficially similar to those used in social learning across the animal kingdom. For example, small fish are sensitive to the age, size, and familiarity of their tutors (Rendell et al., 2011). From an evolutionary perspective, it would be beneficial for young children to be predisposed to attend to behaviors that signal knowledge, success, or status, as these cues could indicate that an individual's behaviors are adaptive and worth copying (Chudek, Brosseau-Liard, Birch, & Henrich, 2013). The early emergence of many selective-learning skills is consistent with this perspective.

We believe that the continued investigation of selective social learning in infancy will have important implications for developmental science. In and of itself, this research will further our understanding of the learning and affiliation strategies and abilities present in the first few years of life. Additionally, this work can make crucial contributions to our knowledge of the cognitive and social underpinnings of social-learning strategies throughout the life span.

Recommended Reading

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Lucas, A. J., & Lewis, C. (2010). Should we trust experiments on trust? *Human Development*, *53*, 167–172. A more thorough discussion of the possible reasons underlying children's

performance on selective-learning tasks, including mental-state reasoning and shallower processes.

Mills, C. (2013). (See References). An article that provides a comprehensive review of the past decade of research examining children's selective social learning.

Over, H., & Carpenter, M. (2013). (See References). An article that discusses motivational aspects of some source-selection tasks—more specifically, those involving imitation.

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