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Abstract word count: 59

Main text word count: 994

References word count: 201

Entire text word count: 1342

Full commentary title: Do knowledge representations facilitate learning under epistemic

uncertainty?

Short commentary title: Learning under epistemic uncertainty

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Abstract:

Phillips and colleagues argue that knowledge representations are more fundamental than belief

representations because they better facilitate social learning. We suggest that existing theory of

mind paradigms may be ill-equipped to adequately evaluate this claim. Future work should explore learning in situations where there is uncertainty about one's own and others' knowledge, which better mirror real-world social learning contexts.

Main text:

Phillips and colleagues posit that the adaptive value of "knowledge before belief" is the superiority of knowledge representations for learning in social contexts. While this hypothesis seems reasonable in the context of paradigms common to theory of mind work, these paradigms eliminate many forms of uncertainty that, in the real world, complicate the process of deciding what to learn, and from whom. In particular, the empirical work featured in the target article leaves little room for (1) uncertainty about the subject's own knowledge and/or (2) uncertainty about other agents' knowledge. Yet, in daily life, people generally experience some degree of uncertainty about these epistemic features. Thus, there is a mismatch between the social learning contexts in these studies and those in the real world.

To illustrate the adaptive learning function of knowledge representations, Phillips and colleagues describe a hypothetical situation in which a ball is placed into one of two boxes in the presence of an agent, and a subject wants to know which box contains the ball. The authors argue that knowledge representations, more so than belief representations, help the subject determine whether they can learn the ball's location from the agent. This situation exemplifies many of the paradigms cited in support of the argument that knowledge representations emerge earlier than belief representations; thus, we will use it to illustrate how these paradigms fail to accommodate various forms of uncertainty that often occur in real-world learning contexts.

The first way in which many theory of mind paradigms eliminate uncertainty is by providing the subject direct observational access to the event of interest (e.g., the ball's location), effectively setting the subject's priors about the event at ceiling (e.g., Bräuer, Call, & Tomasello, 2007; Luo & Baillargeon, 2007). In doing so, these paradigms grant the subject the knowledge that the subject represents in the agent; i.e., the subject knows where the ball is, and they represent that the agent knows where the ball is. This renders knowledge representations inconsequential for learning; the subject already knows what they would otherwise want to learn.

Second, even in paradigms in which the subject does not have direct observational access to the event of interest, the subject usually has direct observational access to the fact that another agent has direct observational access to the event of interest; that is, the subject sees that the agent sees where the ball is (e.g., Behne, Liszkowski, Carpenter, & Tomasello, 2012; Krachun, Carpenter, Call, & Tomasello, 2009). However, in the real world, the set of situations in which people directly observe another individual acquire complete knowledge without acquiring it themselves is narrow. Often, people are uncertain to some degree about whether someone else has relevant knowledge for their own proximate learning goal. For example, if I want to know whether a fruit is healthy, I may rely on my observation of others eating the fruit. However, I cannot be certain whether the fruit-eaters know that the fruit is healthy, whether they are just very hungry, or whether they simply find the fruit tasty. In other words, I am uncertain about whether they know what I am trying to learn.

Similarly, in addition to eliminating uncertainty around *whether* an agent has knowledge, these paradigms also eliminate uncertainty around *how much* knowledge an agent has. In most paradigms cited in the target article, the agent is either fully ignorant (e.g., has their back turned while the ball is placed in a box) or fully knowledgeable (e.g., can perfectly see which box contains the ball) (e.g., Pratt & Bryant, 1990; Sodian, Thoermer, & Dietrich, 2006). Yet, the agents that people seek to learn from are often neither fully knowledgeable nor fully ignorant—they have some amount of relevant knowledge that people must infer from cues such as reputation (e.g., expertise), self-report, or testimony from others.

We believe that a clearer test of Phillips and colleagues' argument about the adaptive value of knowledge representations requires additional empirical investigation into knowledge and belief representations under uncertainty. In situations of uncertainty, do those who can attribute beliefs as well as knowledge still construct knowledge representations with greater automaticity and cognitive ease? Do those who *cannot* attribute beliefs, but can attribute knowledge, still construct knowledge representations? If so, do they act on these knowledge representations as they do in the situations used in existing paradigms? These questions are not an indictment of the knowledge-before-belief claim nor the logic of the hypothesis that knowledge representations are more fundamental than belief representations because they better facilitate learning. Rather, we believe that answers to these questions will elucidate how well early knowledge representations actually facilitate social learning, and thus how likely it is that this adaptive argument applies to learning across contexts and across the lifespan.

While our commentary focuses primarily on two sources of uncertainty underexplored in existing paradigms—uncertainty around one's own and others' knowledge—it is important to note that knowledge representations, on their own, may have limited value for effective social learning absent other mental state representations. In particular, representing the beliefs, desires, or motivations of others is often critical for helping people to figure out whom to learn from. It is important, for example, to know not only who knows what but who can be trusted to share their knowledge, without misleading or obscuring, and without other ulterior motives. Inferring others' beliefs, desires, or motivations could help unlock the adaptive social-learning benefits that the authors argue knowledge representations confer.

In sum, we believe that most existing paradigms examining knowledge attributions in primates and young children do not account for the fact that (1) people are usually learning what they do not already know and (2) people are usually uncertain about what others know and the extent of that knowledge. Under such epistemic uncertainty, do primates and young children still represent knowledge, and, if so, how useful are these representations for learning? Future research that tackles these questions will offer insight into the potential adaptive value of knowledge representations.

Conflicts of Interest: None.

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