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Ignorance matters

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doi:10.1017/S0140525X20001636, e167

Abstract

The ability to reason about ignorance is an important and often overlooked representational capacity. Phillips and colleagues assume that knowledge representations are inevitably accompanied by ignorance representations. We argue that this is not necessarily the case, as agents who can reason about knowledge often fail on ignorance tasks, suggesting that ignorance should be studied as a separate representational capacity.

How do we reason about agents who are ignorant? When we interact with someone that has partial or incomplete knowledge, we can flexibly understand and predict their behavior depending on whether their ignorance is easy to remedy (what's inside this box?), out of their control (will it rain today?), or irrelevant to their goals (do we have free will?). Similarly, when we recognize that we don't know something, we can rectify our ignorance through exploration or by watching more knowledgeable agents act.

Phillips et al. make a compelling case that, within theory of mind, knowledge is a more basic representation than belief. But, in doing so, Phillips et al. also treat knowledge and ignorance as two sides of the same representational coin. However, the representational demands of knowledge and ignorance are not necessarily equivalent. For instance, one of the simplest ways to represent ignorance would be as the absence of knowledge. This, however, would require a negation-like representation of a knowledge state. Because the ability to apply negation over mental representations appears to be absent in younger children (Feiman, Mody, Sanborn, & Carey, 2017; Mody & Carey, 2016; Nordmeyer & Frank, 2014; Reuter, Feiman, & Snedeker, 2018) and is weak in nonhuman primates (Call & Carpenter, 2001), even this simple relationship would already predict that representations of ignorance are not an inevitable consequence of representations of knowledge.

Even if children and nonhuman primates could represent ignorance as a consequence of their ability to represent knowledge, this alone would not provide the computations needed to predict and understand the behavior of ignorant agents, making these representations of limited use. Indeed, predicting the behavior of an ignorant agent goes far beyond merely expecting that they will not act in a knowledgeable way: Accurate predictions about ignorant agents involve determining whether they will

https://doi.org/10.1017/S0140525X20000618 Published online by Cambridge University Press

choose to gather information, and how they will act to maximize their chance of success under uncertainty.

Importantly, these concerns do not simply reflect theoretical questions about the nature of ignorance representations. The few empirical studies that test for an intuitive theory of ignorance suggest that these representations have a tenuous correlation with knowledge representations. Although some sensitivity to ignorance appears early in development (Koenig & Echols, 2003; O'Neill, 1996), children's understanding of ignorance continues to develop after children have a mature understanding of knowledge. Young children exhibit egocentric errors, attributing their own knowledge to ignorant agents (Birch & Bloom, 2003; Hogrefe, Wimmer, & Perner, 1986; Mossler, Marvin, & Greenberg, 1976; Sullivan & Winner, 1991; Wellman & Liu, 2004); they fail to predict that agents searching for a hidden object will choose randomly (Friedman & Petrashek, 2009; Ruffman, 1996); and they do not expect ignorant agents to seek additional information when necessary (Huang, Hu, & Shao, 2019).

Similarly, there is little evidence that nonhuman primates can predict the actions of ignorant agents (Drayton & Santos, 2018; Horschler, Santos, & MacLean, 2019; Karg, Schmelz, Call, & Tomasello, 2015b; Marticorena, Ruiz, Mukerji, Goddu, & Santos, 2011; Martin & Santos, 2016). Many experiments examining nonhuman primate theory of mind directly contrast knowledge and ignorance in a single task, which means that subjects can succeed by (1) only representing knowledge, (2) only representing ignorance, or (3) representing both (e.g., Flombaum & Santos, 2005; Hare, Call, Agnetta, & Tomasello, 2000; Karg, Schmelz, Call, & Tomasello, 2015a), making it impossible to discern which representations are guiding subjects' behavior. Even looking-time tasks that probe knowledge and ignorance under different conditions do not provide clear evidence of ignorance representations. For example, after seeing an object hidden in one of two boxes, rhesus macaque monkeys look equally long at the display when an ignorant demonstrator reaches for the correct or incorrect box (Drayton & Santos, 2018; Marticorena et al., 2011). Crucially, these results are consistent with two competing explanations: Subjects may be unsurprised because both actions are consistent with their prediction that the ignorant agent will search randomly or they may be unsurprised because they made no prediction at all. The former is consistent with Phillips et al.'s proposal that nonhuman primates are able to make predictions about both knowledgeable and ignorant agents. However, the latter would suggest that rhesus macaques either cannot represent ignorance or cannot form predictions about ignorant agents, despite having expectations about the behavior of knowledgeable agents (Drayton & Santos, 2018; Marticorena et al., 2011). Similar concerns also apply to "ignorance" conditions in looking-time studies with infants (Hamlin, Ullman, Tenenbaum, Goodman, & Baker, 2013; Luo & Johnson, 2009).

Taken together, these empirical findings suggest that children and nonhuman primates may not have a rich understanding of ignorance despite being able to successfully reason about knowledgeable agents. This presents an exciting opportunity to reevaluate the common assumption that ignorance representation inevitably accompanies knowledge representation. One possibility is that knowledge is a primary representation out of which ignorance representations are later derived – through negation or otherwise. Such a relationship would explain the developmental lag in ignorance understanding in children and make testable predictions about the status of ignorance representations in nonhuman primates depending on the hypothesized requirements to build this secondary representation. Alternatively, knowledge and ignorance representations may be independent from one another, combining later in life to support reasoning about agents with partial or incomplete knowledge. Critically, in either case, these proposals are consistent with Phillips et al.'s view of the primacy of knowledge representations.

Or perhaps, Phillips et al. are right: Knowledge and ignorance representations may be impossible to disentangle, developmentally indistinguishable (with previous ignorance failures representing only task demands), and best understood in tandem. The task is now to clearly articulate this relationship and design empirical investigations of ignorance representations in their own right, rather than as a control condition for studies of knowledge. A complete account of mental-state representations must explain how ignorance is derived, what (if any) additional representational machinery is necessary, and whether the hypothesized relationship predicts any critical gaps in development of representations of knowledge and ignorance. The answers to these questions are essential not only for understanding this representational capacity, but also for understanding our knowledge representation system and our ability to interpret and predict epistemic actions.

Conflict of interest. None.

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https://doi.org/10.1017/S0140525X20000618 Published online by Cambridge University Press

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Intersubjectivity and social learning: Representation of beliefs enables the accumulation of cultural knowledge

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doi:10.1017/S0140525X20001648, e168

Abstract

I accept the main thesis of the article according to which representation of knowledge is more basic than representation of belief. But I question the authors' contention that humans' unique capacity to represent belief does not underwrite the capacity for the accumulation of cultural knowledge.

The authors make a very good point in demonstrating the fundamental nature of knowledge representation in humans. It has older evolutionary origin than that of belief representation, and that explains why nonhuman primates can do the first but fail to do the second. But is it not a contradiction to argue, on the one hand, that knowledge representation, in so far as it can be seen as a basic cognitive competence, is not distinctive of the human species and, on the other, that what we normally see as the most distinctive characteristic of the human species, which is the capacity to accumulate cultural knowledge, originates in that very same competence? If this is so, one could legitimately wonder why cumulative cultural knowledge is not much more widespread among nonhuman primates than what seems to be the case (Tennie, Call, & Tomasello, 2009; Whiten, 2017).

The authors only mention the accumulation of cultural knowledge at the end of the paper, in section 6.2.1, and they do not elaborate the reasons why they confidently state that "Although the ability to represent others' beliefs may indeed turn out to be unique to humans and critically important for some purposes, it does not seem to underwrite humans' capacity for the accumulation of cultural knowledge." However, this is undoubtedly a key question for all the sciences of human behavior. A priori, one could plainly state that knowledge representation, rather than belief representation, is instrumental to the accumulation of cultural knowledge for the very simple reason that it is "knowledge" what we accumulate, not "beliefs." Does that mean that understanding beliefs is irrelevant in the process of social learning that leads to the accumulation of cultural knowledge?

Belief representation, the authors concede, is relevant for predicting other people's behavior, but it is knowledge, and not belief, "that allows us to represent others as reliable guides to the actual world" (6.1). This is undoubtedly true in a rather obvious sense; but it can also be misleading, for it glosses over the process of social learning as it takes place in all known human societies and that enables any apprentice to acquire knowledge from his or her teacher (Sterelny, 2012). Let me illustrate this with a very simple example. If I want to know how a computer works, I may ask a computer scientist about it. Quite obviously, I am interested in the computer scientist's knowledge about computers, not about her beliefs. But the point I wish to make is that I shall only have access to that knowledge if I am able to understand her beliefs (Salazar, 2018, pp. 37–62).

There is ample evidence that the process of social learning among humans is not simply learning from others, but it is normally conducted within some form of pre-existing social bond (Boyd & Richerson, 1985; Cavalli-Sforza & Feldman, 1981; Henrich, 2015; Kline, 2015; Nielsen, 2008; Zuidema, 2002). More specifically, when social learning entails the transmission of socially shared forms of knowledge, what we normally define as "culture," social learning can only take place when some culturally significant form of social relationship links teacher and apprentice. For the majority of human societies, these social relationships are normally kinship relationships and, more specifically, family relationships, for it is from those that the first and most elementary parts of one's cultural knowledge are to be acquired (Demps, Zorondo-Rodríguez, García, & Reyes-García, 2012; Hewlett & Cavalli-Sforza, 1986; McElreath & Strimling, 2008). This basic nucleus of kinship relations will later be supplemented by other kinds of relationships in different ways. WEIRD (western, educated, industrialized, rich, and democratic) societies are somewhat unique in the sense that they have reduced the social relationship between teacher and learner to the (relatively) impersonal bond created in institutional schooling. However, even when there is some form of selectivity (Bentley & O'Brien, 2011), cultural knowledge is very rarely transmitted between anonymous individuals (cf. Osiurak & Reynaud, 2020).

But why should that be the case? One might be tempted to argue that those networks of social relationships provide a sort of external framework within which "real" knowledge can circulate, but they do not really affect the nature of that knowledge in any substantial way and, crucially, do not transform it into "mere beliefs." Let me show why this cannot be a valid assumption by going back to the simple example of the teacher – computer scientist. The knowledge I am likely to obtain from her will certainly be a partial knowledge about how the computer actually works – otherwise, I would become a computer scientist myself. But, given my ignorance about computers, there is no way I can have access to that knowledge if I have not previously understood what she *believes* to be the case about the computer and, specifically, if I do not trust her (Csibra & Gergely, 2006; see Hewlett, Fouts, & Boyette, 2011). In other words, before getting knowledge from any teacher, I have to believe in that teacher and share her intentionality, so that my knowledge becomes a "dialogic cognitive representation" (Tomasello, Carpenter, Call, Behne, & Mol, 2005). In order to acquire the objective knowledge about the world that will enable me to make use of my computer,