therefore, not quite belief-like in the sense that there is no contrast in content of the egocentric and altercentric representation that could be interpreted as counterfactual (sensu Phillips & Norby, 2021). Egocentric ignorance, thus, constitutes an intermediate representational sophistication – more than knowledge, shy of belief.

False-belief representation is the first situation in which the altercentric representation must not only be held as independent, but the content of this altercentric state must also be updated dynamically. The attributor first tracks the agent as knowledgeable (that "object is in box A"; e.g., as they co-witness a hiding event), then ignorant (that "object is not in box A, object is in box B"; e.g., as the object is displaced in the agent's absence).

True belief representation, at least as exemplified in the Gettier case (Gettier, 1963), constitutes an even more demanding computational task. Here, agents co-witness an object's initial hiding and then, in the agent's absence, the object is temporarily removed and then returned to the same location (Horschler, Santos, & MacLean, 2019; Kaminski, Call, & Tomasello, 2008). Consequently, the requisite updating process involves reconciliation of two contrasting altercentric mental states (knowledge and ignorance) with identical content (object is in location A).

We can now sketch a "scale" of cognitive complexity across the factive and non-factive mental attribution spectrum. Provided she can individuate agents, a hypothetical mindreading attributor can, at the most basic level, track epistemic contact or lack thereof. Egocentric reality alone is sufficient for tracking this minimal notion of knowledge and ignorance. Next, she can attribute copies of her egocentric information, and, in the case of altercentric ignorance, modify them. In egocentric ignorance contexts, the altercentric agent is granted a new epistemic status without the cognitive cost of attributing fully specified content to her. For belief tracking, the content of this altercentric representation is specified and updated. This process is even more computationally challenging in paradigmatic cases of true belief attribution. Finally, aspectuality may (or may not) impose further representational complexity (e.g., Perner, Huemer, & Leahy, 2015; but see Rakoczy, Bergfeld, Schwarz, & Fizke, 2015).

If the present hierarchical characterization is correct, the predictions are clear. Children or animals proficient in more sophisticated abilities should master simpler ones (e.g., Fig. 1 of Krupenye, 2020). Great apes, for example, have shown competence on several recent false-belief tasks (Buttelmann, Buttelmann, Carpenter, Call, & Tomasello, 2017; Kano, Krupenye, Hirata, Tomonaga, & Call, 2019; Krupenye, Kano, Hirata, Call, & Tomasello, 2016), raising the possibility that they may indeed track beliefs. Current evidence is tentatively consistent with the proposed complexity scale, suggesting that apes also track knowledge and altercentric ignorance (Hare, Call, & Tomasello, 2006; Karg, Schmelz, Call, & Tomasello, 2015), and potentially egocentric ignorance (Call & Tomasello, 1999; Krachun, Carpenter, Call, & Tomasello, 2009), but perhaps not Gettier's true beliefs (Kaminski et al., 2008). Cases of egocentric ignorance, in particular however, deserve further, more targeted tests. Broader efforts in humans and nonhumans also demand new tasks that carefully tease apart attribution of knowledge and true belief, and of knowledge, egocentric ignorance, and false belief. Together, these developments will clarify the family, or hierarchy, of factive and non-factive theory of mind.

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The role of epistemic emotions in learning from others

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Abstract

Phillips et al. discuss whether knowledge or beliefs are more basic representations of others' minds, focusing on the primary function of knowledge representation: learning from others. We discuss links between emotion and "knowledge versus belief," and particularly the role of emotions in learning from others in mechanisms such as "social epistemic emotions" and "affective social learning."

Current emotion research emphasizes the existence of a specific family of emotions whose objects are knowledge or the process of knowledge generation/acquisition: these emotions are called "epistemic emotions" or "knowledge emotions" (Brun et al., 2008; Morton, 2010). Unlike achievement emotions, they are not related to the success or failure at a certain task but to the epistemic content or process itself (Pekrun & Stephens, 2012). Examples of currently studied epistemic (or "knowledge") emotions are surprise, curiosity, enjoyment, confusion, anxiety, frustration, and boredom (see Pekrun, Vogl, Muis, & Sinatra, 2017, for the Epistemically-Related Emotions Scale). Epistemic curiosity (i.e., epistemic interest), probably the most widely studied epistemic emotion yet, activates reward-related regions in the brain (Gruber, Gelman, & Ranganath, 2014; Kang et al., 2009). It enhances memory for the content the individual was curious about (Kang et al., 2009) but also of incidental information presented during high states of epistemic curiosity (Gruber et al., 2014). Epistemic curiosity creates additional knowledge exploration and better knowledge acquisition (Ainley, 2017; Wade & Kidd, 2019). Some studies focused on the antecedents of curiosity (Connelly, 2011; Silvia, 2005) to find out what creates curiosity for knowledge in humans. Others have even shown that healthy adults would risk electrical shocks to learn about curiosity-inducing knowledge (Lau, Ozono, Kuratomi, Komiya, & Murayama, 2020).

Although epistemic emotions are personal affective experiences elicited by knowledge, we are not aware of any study that specifically focused on how learners feel epistemic emotions *about knowledge they attribute to others*. For achievement emotions, there is a category of emotions called "social achievement emotions" (e.g., admiration, envy, contempt, and empathy), which is about the success and failure of others (see Pekrun & Linnenbrink-Garcia, 2014). By analogy, we propose the existence of "social epistemic emotions" which refer to the epistemic emotions whose objects are knowledge represented in others. Such emotions, although felt at the first person, would be about third-person knowledge, and be a driving force supporting what Philips et al. consider as the primary function of knowledge representation, namely learning from others. A non-exhaustive list of social epistemic emotions could be: surprise (e.g., the learner is surprised by the representation of the knowledge attributed to the other), curiosity (e.g., the learner feels intrinsically motivated to learn more about the represented knowledge), confusion (e.g., the learner attributes to the social source a knowledge representation contrary to their own prior knowledge, and is experiencing cognitive conflict as a result), and admiration (e.g., the learner is impressed by the quality and/or quantity of knowledge they represent the social source to have). The study of social epistemic emotions should include a broad variety of social sources (e.g., teachers, caregivers, and peers) that play a considerable role in knowledge acquisition (see Harris, Bartz, & Rowe, 2017, for a review on how children turn to their social environment to learn about the world). Social epistemic emotions should help the learner select relevant social sources of knowledge (e.g., through trust-related mechanisms), energize behaviors of knowledge-seeking (e.g., through social interactions) which would eventually lead to actual learning from others. For instance, teacher competence enhances student interest and achievement (Fauth et al., 2019). Research could investigate whether this effect is mediated by the student's representation of the teacher's knowledge. Examples of frameworks in which social epistemic emotions could play a particularly important role are peer-to-peer learning, tutor-student learning, group assignments, debates, and so on.

In contrast to the growing literature concerning the nature and functions of epistemic emotions and the role these emotions play in knowledge acquisition, to the best of our knowledge, there is no category of emotion suggested to have belief – rather than knowledge – as their objects. In particular, we are not aware of any study that aimed at comparing emotions elicited by "knowledge in others" to emotions elicited by "belief in others." We speculate that, because beliefs can be false, if a learner comes across a social source who explicitly expresses their representation as a belief (e.g., by saying "I believe that p"), they will feel less curious and motivated to explore further that representation than if they express it as a knowledge (e.g., " I know that p").

In addition to what has been said on the role of knowledge and belief representations in learning, links may be considered with respect to the robust and growing body of literature on learning from the emotions of others. Affective social learning (Clément & Dukes, 2017), of which "social appraisal" (Fischer, 2019; Manstead & Fischer, 2001, 2017) and "social referencing" (Klinnert, Campos, Sorce, Emde, & Svejda, 1983) are components, posits that others' emotional communication toward an object informs the observer and guides their perception and behavior (Fischer, 2019; Walle, Reschke, & Knothe, 2017). In such phenomenon, emotion is a key component which helps the learner appraise and reappraise their environment (Fischer, 2019; Walle et al., 2017). However, social appraisal is not merely a case of affective priming (Mumenthaler & Sander, 2012) and with respect to interest for instance, it is likely that the emotional communication of others needs to be referencing the object of interest for social appraisal to occur. Most importantly, affective social learning is about transmission of values and not of knowledge about the world (Fischer, 2019). Moreover, social appraisal learning is an active process in which the learner is actively seeking and processing the affective information from the environment (Walle et al., 2017). Social appraisal can operate automatically: Even if contextual social affective information is sub-optimally perceived, it can still influence emotion recognition of healthy adults (Mumenthaler & Sander, 2015).

In short, the target article insists that we use knowledge representation to learn from others about the external world. We agree and would like to add that we also learn from what others feel. Emotional processes such as social epistemic emotions and affective social learning may play a key role in facilitating the way we learn from the knowledge of others and from the emotions of others. A fascinating research question would be to explore whether processes that rely on affective mechanisms to learn from others are primarily knowledge and/or belief-based.

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Knowledge prior to belief: Is extended better than enacted?

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Abstract

In this commentary, we argue that Phillips et al.'s findings can be used to provide new important insights in the debate between externalists' theories of cognition. In particular, we claim that the results presented in this target article may offer us the conceptual palette needed for a sustained defence of an extended account of cognition over an enactive one.

Phillips et al.'s target article, calls for a shift in focus in theory-of-mind research. More specifically, it proposes a new way to understand theory of mind; one that is – unlike previous versions – deeply grounded on comprehending others' minds in relation to the lived world. This affords the authors to formulate an account of knowledge that is relational and factive in character. In addition, such an account is not reducible to the capacity of attributing true belief and is not modality specific, hence not necessarily innate.

We believe that the empirical findings presented in this target article, pointing out the ontological priority of representations of knowledge over representations of beliefs and the crucial role of the former in facilitating learning from others – can be used to shed light on the debate between externalists theories of cognition in the cognitive sciences. More specifically, we believe it is possible to successfully apply Phillips et al.'s results in the debate between the extended mind thesis (Clark & Chalmers, 1998) and forms of enactivism (such as Noë, 2004; Thompson & Stapleton, 2009).

The extended mind thesis (Clark & Chalmers, 1998; Farina, 2020) is a thesis about human cognition that claims that the cognitive processes that make up our minds can (under specific conditions, the so-called glue and trust conditions) reach beyond the boundaries of individual organisms, so as to include as proper, constitutive aspects of the organism's physical and socio-cultural environment (Kiverstein, Farina, & Clark, 2013). In other words, the extended mind thesis sees the body and the environment (or the technological artefacts located in it with which we reliably interact) as precious – *sometimes* constitutive resources (Farina, 2013; Farina & Levin, In Press) – that we can use in order to enhance our cognitive states.

Research on the extended mind thesis is often said to be arising from functionalist views concerning the "multiple realizability" of cognitive processes and indeed quite a few extended mind theorists (such as Wheeler, 2005) are extremely sympathetic to functionalist and mechanistic accounts of the mind. This means that they believe that mental states are identified by their causal roles and not merely by the medium that realizes them (this understanding is grounded on the so-called parity principle). However, there is also a second strand of research characterizing the extended mind thesis, which is more concerned with the complementarity of inner and outer and so with how internal (neural) and external (extra-neural) resources can work together and eventually become integrated or amalgamated (Rowlands, 2010), so as to form a new, enriched system of cognitive analysis (Menary & Protevi, 2007; Sutton, Harris, Keil, & Barnier, 2010). Crucially, neither of these versions of the extended mind thesis gives up the computational power of our brains nor it repudiates the notion of minimally robust representations (Clark & Toribio, 1994).

On the contrary, enactivism, in all its different strands (see Ward, Silverman, & Villalobos, 2017, for a review) attempts to ground cognition in the biodynamics of living biological systems; hence, it describes cognitive behaviour not only as deeply rooted in our engaged, bodily lives but more profoundly as emerging