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ARTICLE



Ontogenetic steps of understanding beliefs: From practical to theoretical

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ABSTRACT

In this article, we postulate that belief understanding unfolds in two steps over ontogenetic time. We propose that belief understanding begins in interactive scenarios in which infants and toddlers respond directly and second-personally to the actions of a misinformed agent. This early understanding of beliefs is *practical* and grounded in the capacity for perspective-taking. Practical belief understanding guarantees effective interaction and communication with others who are acting on false assumptions. In a second step, children, at preschool age, acquire the capacity to reflect on and arrive at third-personal judgments about a misinformed agent's perspective. This capacity is theoretical and grounded in the ability to "confront" perspectives. It allows children to understand that beliefs can misrepresent the state of the world and to predict what (past, future, or hypothetical) actions follow from these beliefs. We conclude with ideas on how practical perspective-taking develops into theoretical perspective-confronting in early ontogeny.

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1. Introduction: Two opposing views about the onset of belief understanding

The capacity to understand one's own and others' action as governed by mental states – which, for better or worse, has been termed a "theory of mind" – permeates human social life. When this capacity emerges in evolution and development, and how one should measure it, are questions that have been debated for more than 40 years (e.g., Dennett, 1978; Premack & Woodruff, 1978; Wimmer, 1998). Most research on this problem has centered on the case of beliefs (and not, say, knowledge, see Phillips et al., 2020), because understanding the possibility of error, which inheres in beliefs but does not come up for factive or conative states, poses a unique challenge.

Two sharply opposed views dominated the debate about when an understanding of beliefs develops: the early-onset vs. the late-onset views (see Chandler et al., 1994). The early-onset view claims that a theory of mind is

present from birth. Leslie (1992, p. 20), for example, states that a theory of mind is a “domain-specific processing mechanism whose task is to understand behavior in relation to mental states. This mechanism is essentially innate and, in some sense, a specific part of the brain”. In the same vein, Onishi and Baillargeon (2005, pp. 256–57) argue that “infants already possess a representational theory of mind: They realize that others act on the basis of their beliefs and that these beliefs are representations that may or may not ‘mirror reality’.” Several infancy studies, most of which measure looking duration, seem to support this view (Kovács et al., 2019; Onishi & Baillargeon, 2005; Scott & Baillargeon, 2009; Scott et al., 2012; Surian et al., 2007). However, many of these studies have not stood the test of replication (Dörrenberg et al., 2018; Kulke et al., 2019; Poulin-Dubois et al., 2018).

The late-onset view regards belief understanding as the product of a conceptual change in the minds of 4- to 5-year-olds (Wellman & Woolley, 1990). Defenders of this view apply much stricter evidentiary standards for belief understanding by expecting correct answers in classic false belief tests. These tests have children articulate their understanding that a person who did not witness an object’s being transferred will misrepresent its location (location-change task; Wimmer, 1998), or that someone seeing a conventional container with unusual content (e.g., a Smarties pouch containing candles) will misidentify what is inside (unexpected-content task; Hogrefe et al., 1986; Perner et al., 1987). Replication and meta-analytic studies confirm that children younger than 4 to 5 years typically fail by answering where or what the object really is, rather than where or what it is in the mind of the misled agent (e.g., Wellman et al., 2001). Understanding beliefs, in this view, relies on general-cognitive capacities including language (Hale & Tager-Flusberg, 2003; De Villiers, 2000), executive control (Carlson & Moses, 2001; Leslie & Polizzi, 1998), and perspectival representations (Perner et al., 2003). It is the presence of these capacities that explains correlations between belief understanding and counterfactual reasoning (Guajardo et al., 2009; Rafetseder & Perner, 2018), understanding identity relations (Perner et al., 2007), the appearance-reality difference (Perner et al., 1987), and even autobiographical memory (Perner, 2000).

Early-onset defenders counter that the pragmatic sophistication (Hansen, 2010; Helming et al., 2014; Siegal & Beattie, 1991), inhibitory control (Birch & Bloom, 2003; Hala et al., 2003; Leslie et al., 2004; Moses, 2005; Roth & Leslie, 1998), and working memory (Scott, 2014) needed to pass the standard tasks have nothing do with belief understanding and exceed infants’ processing capacities, thereby masking early belief comprehension (Baillargeon et al., 2010; Leslie, 2005; Scott, 2017; Setoh et al., 1991).

2. The “third way”: Developmental steps toward a full understanding of beliefs

A third alternative, which we defend, is to evade the all-or-nothing character of the early- and the late-onset views and argue that a theory of mind does not spring into existence at once, either at birth or at 4 to 5 years, but develops in steps. Two influential accounts that have already argued for this or a similar position are the two-systems account (Apperly & Butterfill, 2009; Butterfill & Apperly, 2013) and the teleology-in-perspective account (Perner & Roessler, 2010, 2012). In this short section, we give a brief overview of these two accounts by presenting their main claims. In Section 3, we will articulate how our account differs from these two and what positive contribution our account is trying to make.

Apperly and Butterfill (2009, p. 956) claim that belief understanding, defined as “exercising an ability to deal with tasks in which belief matters” is handled by two cognitive systems. System 1 is innate, shared by humans and certain other animals (e.g., chimpanzees), and works independently of language or executive control. It lets infants track with which objects other agents interacted where, with the effect that infants know where others “register” objects – a relational analog of “believe”. It is this system that explains why infants and toddlers show potential success in studies (again, with their replicability being questioned) that the early-onset view cites in its support (e.g., Scott & Baillargeon, 2017).

According to the two-systems account, infants’ minimal theory of mind is later complemented by a deeper, human-unique, understanding of the mind offered by System 2 (Low et al., 2016). System 2 represents beliefs as such and recognizes the mode of presentation or aspectual shape in which a person views or construes an object. This system starts to form at around age 4 to 5, with its emergence being contingent on the child’s developing language and executive control skills. Once System 2 is in place, children understand that objects can be misrepresented (Perner et al., 2007; Rakoczy et al., 2015) and understand what role beliefs play in a larger web of interrelated mental states that sustain, cause, or provoke revisions of each other. Humans rely on System 2 to pass standard theory of mind tests.

The teleology-in-perspective account by Perner and Roessler (2010, see also Roessler & Perner, 2013) offers a new perspective by treating beliefs and other mental states as only secondary ways of making sense of human action. In this account, children by age 3 are teleologists who seek reasons for people’s intentional actions. But the only kind of reason for action children can imagine at this age are *objective reasons* or worldly facts: Maxi has reason to look for his chocolate where it is, e.g., in the cupboard, just like the schoolgirl has reason to go to school at 8am because that is when school starts (not because that is when she *believes* school starts). Three-year

-olds' judgment that Maxi will look for the object in its actual location is thus, in this account, not evidence that they cannot resist the "pull of the real", as the early-onset view argues (Baillargeon et al., 2010), but a manifestation of sound practical reasoning (Roessler & Perner, 2013, p. 37). It is just that children at this young age only recognize what someone objectively has reason to do and not what is rational, from her subjective perspective, to do (the "ought of reason" versus the "ought of rationality", Kolodny, 2005). This changes at age 4 to 5, when children invoke *subjective reasons* for action and understand, e.g., that it is rational for Maxi to look for his chocolate in the drawer if that is where it is according to his belief, or that it is rational for the schoolgirl to go to school at 9am if she thinks that that is when school begins. Children now understand teleology from the agent's subjective perspective, so that actions (e.g., searching for something in an empty location) and feelings (e.g., being upset about something that did not actually happen) that would be otherwise unintelligible are recognized as rational.

Perner and Roessler (2010) also show how children, before they understand beliefs as subjective perspectives, might still anticipate where an agent with a false belief is moving (see also Perner et al., 2007; Perner & Roessler, 2012). This is because infants keenly observe others' interactions with objects and maintain records of others' experiences ("experiential records"). These records get activated once the agent returns (or when her return is announced), with the effect that children view the scene from the agent's perspective. When this happens, however, children do not think of the ongoing activity as intentional action, and they do not invoke beliefs to explain that action. Having witnessed what the agent was previously doing, coupled with the agent's return, simply lets infants resume where the activity left off.

3. Our proposal: From practical to theoretical belief understanding

The two accounts reviewed above must be credited with having moved the debate about theory-of-mind development beyond the dichotomy of nativism versus late acquisition by articulating developmental steps toward a full appreciation of beliefs. We largely agree with these new proposals, although we think that they miss something important, namely that the progression in children's understanding runs from practical to theoretical and reflective understanding of belief. In the following, we articulate the differences between their positions and ours and highlight the positive contribution our account tries to make.

We agree with Apperly and Butterfill (2009) that belief understanding emerges not all at once, but we propose that the line between early- and later-developing belief understanding be drawn along a different dimension.

These authors separate infants' from preschoolers' theory of mind by what it is that each represent, with infants representing not beliefs but so-called "registrations". But what this mental state that falls short of being a belief is remains opaque, as it is purported to be neither a spatial agent-object relation (registrations are argued to be fallible mental states) nor an agent's representation of an object (registrations are explicitly nonrepresentational). To avoid the conceptual confusion, we stick to beliefs as the object of understanding for infants and preschoolers, and instead propose that children first understand them at a practical level before forming a theoretical understanding of beliefs.

A further difference is that for Apperly and Butterfill (2009), infants share their minimal theory of mind with other animals, whereas in our account, infants' early belief-sensitivity is part of their uniquely human capacity for shared intentionality. Early sensitivity to beliefs serves the kinds of cooperative interactions only humans perform (Moll & Tomasello, 2007; Tomasello et al., 2005). For example, toddlers' practical grasp of beliefs allows them to inform others about events and thus help others update their knowledge or achieve their goals. These kinds of cooperative acts are not in the repertoire of other animals. The ancient and rigid nature of System 1 also commits Apperly and Butterfill (2009) to arguing that infants' belief sensitivity is unaffected by the social experiences that the use of this system enables. We, by contrast, assume that using one's practical understanding of beliefs leads to further refinement and growth of these capacities.

A third difference lies in the sorts of capacities that we and Apperly and Butterfill (2009) ascribe to infants. They argue that infants "predict" what someone's encounters with and registrations of objects will lead them to do. But this conflicts with infants' and toddlers' reliable and systematic failure in predicting false-belief situations. We propose a distinction (one that is backed up by etymology and differences in current meaning) between anticipation and prediction, such that infants can *anticipate* but not *predict* misled agent's next moves. The difference is that predicting (lt. praedicere = to assert, publicly declare) is a theoretical capacity to explicitly foretell future events and their outcomes. Predictions are linguistic or symbolic *ex ante* judgments that can be compared with actual events. Anticipating (lt. ante + capere = to capture in advance), however, is a practical capacity to prepare for an event that is about to occur. Anticipations do not necessarily require language but only demand that one align one's behavior with an imminent event. Contra Apperly and Butterfill (2009), we thus argue that children under age 4 fail standard tests because they lack the theoretical capacity to predict false-belief involving actions.

In relation to Perner and Roessler's (2012) proposal, ours emphasizes children's primary role as agents, while theirs is mainly concerned with children as thinkers contemplating reasons for action. The authors set out

to correct the standard story according to which predicting, explaining, and justifying actions afford a theory of mind. The authors show that on many occasions, all that is needed is what 3-year-olds can already do, which is to point to reason-giving worldly facts (e.g., the fact that the chocolate is in the cabinet is reason for Maxi to look there). We find this helpful to make better sense of 3-year-olds' systematically false answers. We also share Perner and Roessler's (2010, see also Roessler & Perner 2013) framing of beliefs as perspectives, which acknowledges the common denominator between belief understanding and, e.g., understanding visual perspectives or the appearance-reality difference. Yet, these authors do not argue that infants start to understand beliefs practically as they interact with others. The authors are primarily concerned with children as reasoners who try to discern, from a contemplative distance, what others might do and why. We instead highlight that infants and toddlers start by showing sensitivity to others' beliefs in the role of agents, indicating a practical form of understanding.

By putting the practical before the theoretical, we reject the portrayal of infants as little scientists (Gopnik et al., 1999). We instead side with those who have argued before us that children are agents before they are contemplators (Macmurray, 1961), that a grasp of other minds takes shape in interaction (Carpendale & Lewis 2004; Gallagher, 2017; Satne, 2020), and that cognitive development entails a progression toward more theoretical or meta-forms of understanding one's actions (Karmiloff-Smith, 1983, 1986). By placing the practical before the theoretical, we support Ryle's (1946/2001) idea that "knowing-how" or intelligent action is irreducible and prior to "knowing-that" or intelligent ratiocination. Before children contemplate propositions, they skillfully use knowledge that later gets articulated in propositions. The progression from practical to theoretical also corresponds with the assumption that evolutionarily, cognition serves action. We are aware of the tiger so we can run from it. Shared intentionality theory, which we endorse, extends this idea to social cognition, arguing that humans' early sensitivity to others' mental states serves first and foremost cooperatively organized interaction (Moll & Tomasello, 2007; Tomasello et al., 2005). Belief understanding, at its first, practical, level, ensures effective helping, cooperation, and communication when one's partner's epistemic perspectives are not aligned with one's own. This early understanding is *second-personal*, because it is exercised exclusively in interaction with another person.

At age 4 to 5, children additionally form a *theoretical* understanding of beliefs, allowing them to step into a reflective position from where they can confront or juxtapose someone's subjective take on reality with some other, including an objective, way of viewing that same reality. This theoretical understanding is crucial for engaging in social discourse that aims to make

sense of human action by discerning people's beliefs, assumptions, or expectations, and seeing how they explain or motivate a certain course of action. We thus agree with the late-onset view that a *theoretical understanding* or, what has been called a *theory* of mind, is not in place before age 4 to 5. What the late-onset view has overlooked, however, is the fact that this understanding is preceded by a practical understanding that allows even infants to smooth over epistemic gaps and “fix” others' beliefs in direct interaction.

In the next section, we give an overview of how toddlers manifest *practical* belief understanding, including acts of helping (such as informing others), anticipatory action, and reference recovery in communication. Here, we also briefly discuss how infants' ability to perceptually discriminate between belief-consistent and belief-inconsistent behavior might be interpreted. In [Section 5](#), we introduce preschoolers' *theoretical* belief understanding, which includes the abilities to predict, explain, and justify actions with recourse to beliefs. In [Section 6](#), we recapitulate the differences between practical and theoretical belief understanding, before offering concluding remarks on how practical might unfold into theoretical understanding in [Section 7](#).

4. Practical belief understanding: Epistemic perspective-taking

Here, we review studies showing that infants and toddlers have a practical way of understanding beliefs. There are two ways in which this understanding is practical. First, the mode of expression is practical. Infants manifest their understanding in *action*, through the use of *know-how* or skills, not through contemplation or reflection. Second, the object of this understanding is practical. What infants understand is (belief-dependent) action, not how someone contemplates or thinks about a problem. This practical capacity is *second-personal* because it equips its bearers with the capacity to interact effectively with others whose acts are misguided – as is shown in [Figure 1](#) (left panel). This ability makes infants' skills of shared intentionality robust against disturbances from epistemic incongruencies between them and their partner. We now turn to empirical indications of practical belief understanding and how it gradually gains complexity over time.

4.1 Helping and reference resolution

One way in which infants express practical belief understanding is by helping misinformed agents achieve their goals. Buttelmann et al. (2009) had 18-month-olds witness how an adult placed an object in a box. Another person then moved the object to a different box either surreptitiously or with the adult watching. When the adult later tried to open

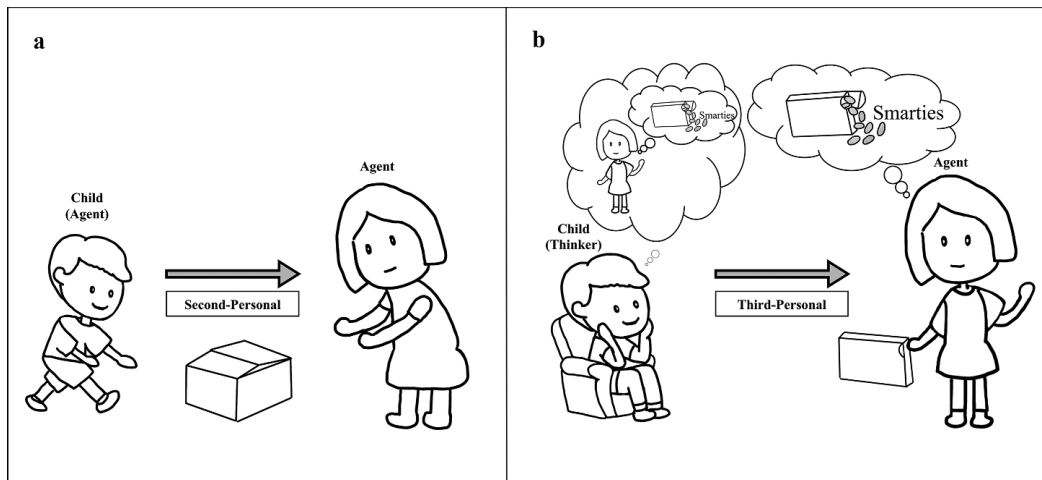


Figure 1. Practical (A) and theoretical (B) belief understanding as evidenced by children in behavioral and interactive tests (A) and in the classic or standard tests (B).

Note: Behavioral and interactive tests measure practical belief understanding (A). In these tests, the child interacts second-personally with a misinformed agent and either helps her achieve her goals or anticipates her next action steps. Standard tasks (e.g., the unexpected-content task) measure theoretical belief understanding (B). In these tasks, the child third-personally contemplates an agent's epistemic attitude toward a state of affair.

the now empty box, infants reacted differently depending on what the adult had seen: They retrieved the object from its new location if the adult had been absent, but they helped the adult open the box if the adult had witnessed the transfer. Depending on condition, infants perceived the adult as striving for different goals. If the adult failed to see the object's relocation, they took her to be pursuing the relocated object. If the adult saw the transfer, they assumed she must want something else from the empty box (e.g., place an object inside; see, Allen, 2015; Priewasser et al., 2018, for partial replications; Crivello & Poulin-Dubois, 2018, for a failed replication).

Children accomplish something similar when they recover a speaker's reference whose utterance is rooted in false assumptions. In Happé and Loth's (2002) version of a word-learning paradigm introduced by Baldwin (1993), 3- and 5-year-olds inferred different referents depending on the speaker's epistemic background. When the speaker used a novel word while pointing to an opaque box ("There is a modi in here!"), children associated the label (modi) with the box's content if the speaker knew what the box contained. But when the content had been replaced unbeknownst to the speaker, children associated the label with the removed content (see also Carpenter et al., 2002). In a simplified task version with 17-month-olds, the speaker pointed at a box asking for the "sefo" after failing to witness that the

box's content was exchanged (Southgate et al., 2010). Similar to Buttelmann et al.'s (2009) helping study, most infants fetched the object that had been relocated.

If replicable, these studies show that infants can discern action goals and recover speech referents of those who act under false premises. Infants skillfully override salient spatial connections between others' (speech) behavior and its spatial targets (the empty box in Buttelmann et al.'s (2009) study or the new content in Happé and Loth's (2002) study) and instead connect the behavior to spatially incongruous but intended targets. Infants thereby ensure the achievement of their partner's instrumental or communicative goals.

4.2 *Anticipatory action*

Because action is teleological, understanding action involves some degree of anticipation of where things are headed. This is crucial for cooperation and communication, because in order to successfully align one's actions with those of one's partner, one needs to have a sense of what the other does next. Do toddlers have such anticipatory skills? In one study, children between 2.5 and 4.5 years saw how a mouse placed a piece of cheese in front of one of two holes (Clements & Perner, 1994). When the mouse was about to return after her cheese was inconspicuously moved in her absence, children aged 3 and older looked to where the mouse had left the cheese, whereas younger children looked to the cheese's location (see Ruffman et al., 2001, for a replication with 3-year-olds and He et al., 2012, for similar data with 2.5-year-olds). Southgate et al. (2007) found the same with 25-month-olds after removing the object entirely, thereby eliminating the curse of knowledge (Birch & Bloom, 2007; Wimmer, 1998). These reports suggest that 2-year-olds can perceptually anticipate a misled agent's action. Problematically, however, anticipatory-looking studies have largely failed to replicate, not only in toddlers (Kampis et al., 2021; Kulke et al., 2018; Schuwert et al., 2018; Wiesmann et al., 2018), but also in older children and adults (Burnside et al., 2018). It is thus uncertain whether humans perceptually anticipate others' misguided steps in the way that has been proposed.

A study using more demanding responses found that 3-year-olds show anticipatory motor movements in false-belief contexts. Garnham and Perner (2001) had children quickly place a mat to soften an agent's arrival at one of two slides: one leading the agent to her ball or one leading to where she left, but would no longer find, the ball. Where children placed the mat depended on condition. When the agent's belief about the ball's location was outdated, children placed the mat under the slide leading to where the agent had left the ball but would no longer find it. When the agent had witnessed the transfer and thus knew the ball's location,

children promptly placed the mat under the slide leading to the ball. Three-year-olds can thus anticipate others' belief-involving behavior in their motor actions.

Children's practical belief knowledge thus gradually comes to include increasingly more complex anticipations. These anticipations are limited in their reach and are not the same as predictions. Predictions precede an event, are explicit (allowing for a comparison between the predicted and observed) and, in the context of belief understanding, require awareness that the agent misrepresents reality and will miss her goal. Anticipations, by contrast, are embedded in ongoing activities and do not reach past the immediate next steps. They are implicit in the sense that they are available only for pragmatic action responses, not for symbolic ones, such as verbal or gestural answers (for more on implicitness, see Rakoczy, 2012). Anticipations require no awareness of misrepresentation. By anticipating what happens next, infants are able to intervene correctively, either as they help others achieve their goals (thereby turning an individual act into a joint act) or as they participate in cooperatively structured forms of communication, such as requests or informative acts.

4.3 Warning others

Knudsen and Liszkowski (2012a, 2012b) examined whether infants warn others about the unwitnessed presence of aversive objects. In their modification of O'Neill's (1996) pointing paradigm, infants pointed out an aversive object for an agent more often when the agent was ignorant (2012a) or mistaken (2012b) about where the object was than when she knew of its whereabouts. They closed an epistemic gap between themselves and the other. What is unclear, however, is what role the object's aversiveness played and whether infants' pointing was driven by a concern that the other may be harmed. To get clearer on this, one could test whether infants point more excitedly or more often when an object that an agent is about to encounter is aversive than when it is neutral.

Also unknown is whether infants *prevent* others from encountering danger, e.g., by blocking access to potentially harmful sites. As we will discuss in Section 6, unlike warnings, acts of preventions lie at the border between a practical and theoretical belief understanding. Preventions can be argued to involve an outcome's prediction from a theoretical distance, rather than simply the ad-hoc anticipation of what is about to happen in an ongoing activity.

4.4 Looking time differences: A basis for practical belief understanding

One might wonder how looking-time data with infants too young to help, comply to requests, or produce informative gestures for others, fit into our two-step account of belief understanding. The early-onset view argues that

half-year-olds, who cannot perform any of these practical tasks, have a fully-fledged understanding of beliefs. In one paradigm, infants look longer when an agent's action is belief-incongruent (her behavior mismatches what she previously witnessed) than when it is belief-congruent (her behavior matches what she previously witnessed; see Onishi & Baillargeon, 2005). In another paradigm, infants look longer when shown a scene that should surprise another agent who lacks crucial information (she failed to witness a ball rolling away from behind a barrier), although it should not surprise the infants themselves (Kovács et al., 2010). As mentioned, one issue is that successful independent replication of such looking-time differences remains outstanding (Kulke et al., 2018, 2019; Poulin-Dubois et al., 2018). Another issue is that even if the findings turn out replicable, lean interpretations are called for because of the low-level nature of the behavior (Aslin, 2007). The early-onset view's interpretation that longer looks indicate a violation of belief-based action predictions (Baillargeon et al., 2010; Onishi & Baillargeon, 2005) is overly rich, especially considering the fact that direct measures have reliably shown that children younger than 4 cannot perform them. A leaner and more realistic interpretation is that infants simply notice the difference when an agent's behavior is in step with what she previously observed or not. Infants' curiosity might be heightened in the latter case. Such curiosity could be the motivational basis for children's perspective-taking in belief contexts, when they attempt to determine what another agent is trying to do and how she might be helped.

4.5 *Interim conclusion*

The studies reviewed above suggest that infants and toddlers interact sensibly with persons who are led by false assumptions. They intervene correctively, secure reference, inform others, and anticipate (e.g., through motor actions) what others do next. In doing these things, children “successfully navigate the social interaction” (Hersbach, 2008, p. 46) when they and their interaction partner act from different epistemic backgrounds, including when the other's actions follow from false beliefs. All of this allows children to help a misled agent get back on track – be it by investing in an action that started out as another's individual project or by contributing to a cooperatively organized action, e.g., by satisfying another's ill-formulated request.

To do these things, children need to know what their partner's goal is and how her prior experiences (what she did and did not witness) impact her course of action. But they need not represent the other person as being mistaken about the state of reality, whether by representing false beliefs or simpler analogs like false or outdated “registrations” (Apperly & Butterfill,

2009). Proof of awareness of someone's being mistaken is given only by committing oneself to a theoretical stance about what it is that an agent believes or what this belief will motivate the agent to do. As we shall show in the following, only standard false-belief and similar tests from the theory of mind test battery require such commitment.

5. Theoretical belief understanding: Confronting beliefs with reality

In standard false belief tasks, 3-year-olds not only mostly give wrong answers, but they give them promptly (Atance et al., 2010) and with great confidence (Ruffman et al., 2001). A transition toward correct answers is thus not yet in place, since such transitioning would manifest in hesitant and inconsistent answers (Perner & Roessler, 2012, p. 524). The question thus arises why 3-year-olds, who have been practically sensitive to others' beliefs for one to two years, are not ready, despite having the necessary vocabulary, to give the right answers to questions about false beliefs.

Passing these tests affords the realization that the character's representation clashes with reality, i.e., that it is wrong. Asking the child about the character's take on the situation forces the child into a contemplative position from which she reflects on the agent's attitude toward the problem of where or what the object is. The child thus deals with someone's attitude toward a state of affair, not, as in practical tests, with someone's relation to an object. The child need not be directly asked whether the character is right or wrong in how she represents the state of affair. It suffices to have the child articulate what the character believes ("Maxi thinks the chocolate is in the drawer") because this belief's conflict with reality is evident. Alternatively, the child can be brought to i) predict what the person will do (Maxi *will* look for his chocolate in the empty drawer), ii) recall ("retrodict") what the person did before she discovered reality (I *said* "Smarties" when first asked what the box contains), or iii) state hypothetically what anyone under the given circumstances would do (e.g., anyone seeing the Smarties pouch *would* say it contains Smarties, see the right panel of Figure 1). The child's responses need not be verbal to have the status of judgments so long as they are symbolic. For example, pointing to a location (in the location-change task) or to an image of the expected content (in the unexpected-content task) counts as a truth-functional judgment if the gesture is used to demonstrate how a character thinks about the state of affair. Studies in comparative psychology have shown how question-response formats can even be altogether avoided and still measure theoretical belief understanding. In these non-verbal paradigms, for participants to make strategic choices, they need to infer what a competitor did on her previous turn, which the participants did not get to watch (Kaminski et al., 2008; see also

Call & Tomasello, 1999). Consistent with our theory, children under age 4 and non-human apes fail tasks like these that involve reflection on, and prediction of, another's belief-involving action.

Judgments bring out false beliefs' failures to accurately represent the world because they force the child to think about a view of the world that conflicts with reality as it is. Such judgments are at the core of explanations and justifications of human action that seems *prima facie* irrational. These judgments make intelligible why a person acted or will act in a particular way although this way of acting is not conducive to the agent's achieving her goal (Perner & Roessler, 2012; Roessler & Perner, 2013).

As is the case for its practical analog, theoretical belief understanding does not form once and for all but matures throughout young childhood. The ability to predict actions based on beliefs develops either slightly earlier or concurrently with the ability to explain actions through beliefs (Wimmer & Mayringer, 1998). An understanding of intensionality, i.e., that replacing co-referring terms in propositional attitude reports might change these reports' truth-value, develops either at the same time as (Rakoczy et al., 2015) or slightly after (Apperly & Robinson, 2003) the ability to predict false-belief-involving actions. It has been suggested that it takes children some time to learn how epistemic states inform affective states. For example, although 4- to 5-year-olds know that Little Red Riding Hood mistakes the wolf for her grandmother, they nonetheless think that she is frightened (Ronfard & Harris, 2014). From around age 4 onward, children thus gradually expand their knowledge of how beliefs are formed and hang together with other psychological states and action dispositions (Butterfill & Apperly, 2013). What we subsume under a theoretical form of belief understanding is thus a collection of various ways of relating human thoughts with actions and feelings.

In the next section, we recapitulate and further define the differences between practical and theoretical belief understanding.

6. Defining the difference

Table 1 lists key differences between practical and theoretical belief understanding.

In tests of practical belief understanding, the child directly and second-personally interacts with another agent, e.g., by helping a person find things (e.g., Allen, 2015; Buttelmann et al., 2009), complying with her request (e.g., Happé & Loth, 2002), or warning her (Knudsen & Liszkowski, 2012a, 2012b). In tests of theoretical belief understanding, the child does not interact with a second person, but is presented with a story character whose belief or belief-based actions she must identify. The child's relation to the character is third-personal (see Figure 1). She reflects on the

Table 1. Differences between practical and theoretical belief understanding.

Dimension of Difference	Level of Belief Understanding	
	Practical	Theoretical
Agent/Character	other agent	character (self, other, hypothetical)
Child-Agent Relation	second-personal	third-personal
Response Prompt	agent's ongoing activity (request)	discourse about belief (question)
Response Type	intervention (helping, warning etc.), (anticipation perceptual, motor)	judgment (prediction, retrodiction, hypothetical statement)
Response Evaluation	situational appropriateness	truth
Perspective Ability	perspective-taking (with anticipation)	perspective-confronting (with prediction)
Necessary to understand falseness of belief?	no	yes

character's epistemic attitude, with the possibility that the character is the child themselves, such as when the child tries to recall her own past false belief in the unexpected-content task. The limited use of practical belief knowledge in the moment of ongoing interaction has now clearly been transcended, as the child can now reflect on any belief-involving situation, whether past or future, real or hypothetical.

Note the correspondence, both at the practical and theoretical level, between how the child responds (response type) and to what she responds (response prompt). In practical belief tests, the child acts in response to another's action. For example, an agent tries to open a box and the child helps with the action. In theoretical belief tests, the child makes a judgment about another's judgment about a state of affair. The standards of evaluation differ accordingly: In practical contexts, we determine if the child's response is *appropriate* to the other's epistemic stance. For example, warning another person is a more appropriate action response when there is some indication that the person is ill-informed than when she is well-informed. In theoretical contexts, by contrast, truth conditions are applied to decide if the child's judgment about someone's epistemic attitude is correct or incorrect.

These differences show that infants' and preschoolers' belief-related capacities are distinct and grounded in different psychological processes. We propose that these processes are perspective-taking and perspective-confronting, respectively. Perspective-taking involves tracking what others have and have not interacted with or experienced, which infants in their second year of life skillfully do (Moll et al., 2007). Beyond tracking another agent's experience, perspective-taking also includes anticipating what the agent, given what she did some moments ago, is going to do.

These anticipations are generated from past (first-, second-, and third-personal) experiences of situations similar to the agent's, such as returning to where one left a toy in order to fetch it. As laid out above, anticipations are embedded in and limited to the activity that elicits them. Hence, perspective-taking is only available *in actu*: it requires an agent to whose activities the child can react, just like actualizing one's ability to catch a ball requires a ball in mid-air to be caught. Both entail anticipation (of the other's next moves/the ball's flight path) but not prediction. Predictions take the form of judgments about future or hypothetical outcomes, "Maxi will not find his chocolate", "The ball will end up in the tree". Predictions are not, as are anticipations, a practical capacity embedded in action, but a theoretical capacity that can be actualized any time and thus outside of any ongoing activity.

To be able to think theoretically about someone's perspective outside of a particular social situation, one needs to be able to "confront perspectives" (Moll & Kadipasaoglu, 2013; Moll & Meltzoff, 2011b, 2011c). In the context of belief understanding, this means being able to juxtapose an agent's false belief with reality in full awareness of their clash. The reason why the child does not need to articulate the state of reality is that the articulated belief clashes so obviously with it. The same holds for perspective tasks in other, e.g., visuo-spatial, contexts in which children only need to be asked how someone else views a scene, without needing to also articulate their own view (Moll et al., 2013). Unlike perspective-taking, the ability to confront perspectives is not bound to ongoing social interaction. It is a capacity that can be actualized with reference to any real or potential belief-involving scenario. The child can now ask herself what she or any hypothetical person would do if she were ill-informed or viewing a scene from an alternative standpoint. It is for this reason that theoretical belief understanding correlates with counterfactual thinking (Guajardo et al., 2009; Rafetseder & Perner, 2018) and can be tested with first-, third-, or impersonal ("What would someone who does not know x do in y situation?") test versions of the unexpected-content task. Practical belief understanding, by contrast, necessarily involves a concrete agent to whose activities the child is reacting.

Importantly, the boundary between practical and theoretical understanding is not clear-cut. We now list two existing tasks and propose the construction of a third task that we see as lying at the border of practical and theoretical belief knowledge. Some aspects of these tasks suggest that they test practical belief understanding, while other aspects suggest that a dawning theoretical understanding is required. Consistent with our proposal that these tasks capture borderline cases, children who have solved the existing tasks were at least 2.5 to 3 years old and are thus slowly approaching the threshold at which a theoretical belief understanding emerges. One of the tasks uses a suspense paradigm, in which children express suspenseful

tension, as shown by lip biting, brow furrowing, or clinging to their chair when watching an ill-informed (but not when watching a well-informed) agent approach a box whose content was replaced (Moll et al., 2016, 2017). Because the expressions are anticipatory reactions embedded within another's ongoing activity, practical belief understanding seems to be at work. However, these toddlers appear to have a sense of the way in which unexpected reality is going to emotionally affect the agent, which can be argued to involve theoretical knowledge of the effects of having one's expectations violated.

Another study used what we might call a narrative-completion paradigm. In this study, 3.5-year-olds acted out the final part of a false-belief scene by having a misinformed toy figurine step toward the outdated location of her desired object (Rubio-Fernández & Geurts, 2013). The action response of placing the figurine suggests practical belief understanding. However, rather than second-personally interacting with the figure, children manipulated the figure like a character in a story to demonstrate how the scene would unfold. Children acted on, rather than interacted with, the story character, suggesting that theoretical belief knowledge may have been in play. Unfortunately, a recent attempt to replicate this study's findings failed (Priewasser et al., 2020), so that the interpretation we offer pertains to a hypothetical result.

Finally, another potential study that has, to our knowledge, not been conducted but is proposed here, is one in which the child *prevents* an agent from accessing a site that has become hazardous since the agent left. Similar to the warnings observed by Knudsen and Liskowski (2012b), preventions are action interventions for which, *prima facie*, a practical belief understanding seems sufficient. However, unlike second-personal warnings ("Hey you, watch out!"), preventions rest on (impersonal) predictions of how a hypothetical event, were it come to pass, would conclude. Devising and comparing more tasks of the kind mentioned here will help to better understand what smaller, incremental, steps children take to move across the threshold between practical and theoretical belief understanding.

7. Closing remarks

In this article, we tried to show that infants and toddlers are skilled at taking others' epistemic perspectives in pragmatic contexts. By age 1 to 2 years, they can bridge epistemic gaps between others and themselves in communication and cooperation, for example, by helping someone find their relocated object, or by recovering the referent of an interlocutor's speech act. However, the data indicate that infants and toddlers do not yet

understand that the perspectives of their interaction partners are false representations of reality. Similarly, in the context of visual perspective-taking tasks, toddlers do not yet understand that the perspective they are adopting in interaction is but one of several, equally veridical, ways of looking at the world (Moll & Meltzoff, 2011a, 2011b).

Ryle's (1946/2001) metaphor of looking through different glasses is illustrative here. Infants and toddlers look through different glasses at different times. In doing so, they perceive the world from different vantage points, including through the eyes of those whose actions are guided by false assumptions. This "lens-switching" allows children to skillfully interact with other agents, for example, by directing them toward relocated objects and thus helping them meet their action or speech goals (requests). Switching lenses in this way guarantees robust communication and cooperation when self and other act from different epistemic backgrounds, including when the other's actions are grounded in false beliefs. But before age 4 to 5 years, children merely *use* these glasses *practically* without knowing about them or how they affect the one looking through them. Toddlers, in other words, have relevant know-how in dealing with situations in which false beliefs are in play, but they lack awareness that beliefs can be false or that objects or scenes can be viewed from different viewpoints. Before 4 to 5 years old, children do not look at or contemplate the glasses they have practically been using in social interaction; they do not reflect on how one's perception or representation is shaped by one's perspective. This awareness, for which the standard belief tests remain useful and valid test instruments, develops between 4 and 5 years. At this age, children no longer just *know how* (practical knowledge) to take perspectives but *know that* (theoretical knowledge) perspectives can differ and fail to represent reality as it is. The developmental progression from practical to theoretical belief knowledge bears resemblance with Karmiloff-Smith's (1992, 1994) representational redescription account, according to which cognitive growth consists largely of a reiterative process in which children step up to a "metaprocedural level" from where they oversee and coordinate their action procedures. In her analysis of how children advance to higher and more theoretical forms of understanding, Karmiloff-Smith (1983, 1986) also identifies – as do we – conflict, brought to children's awareness in linguistic discourse (e.g., an adult pointing out a child's conflicting uses of pronouns), as a driving force behind representational change.

For the question of how infants' perspective-taking skills are acquired, we point to Bruner's (1974) insight that "acquisition is initial use". On this view, children acquire practical belief understanding in the context of the same sorts of cooperative and communicative exchanges in which it first manifests. Support for this comes from studies showing that second-personal engagement is key for the development of perspective-taking. For example,

it has been shown that initially, infants can only discern which of several objects is new versus familiar for another if the new object sticks out against a background of prior shared interactions (Moll et al., 2007, 2008). Simply observing, from a detached, third-personal, standpoint does not, at least initially, allow infants to grasp what others are experiencing. It is thus in the same kinds of second-personal interactions in which infants display their practical perspective-taking skills that this perspective-taking ability first arises.

Shared intentionality remains crucial for children's later development of theoretical belief understanding. Several studies have shown that parents' use of mental state terms like "think" and "know" in conversation, e.g., during joint book reading, predicts concurrent and later false belief understanding (Ensor et al., 2014; Howard et al., 2008; Meins et al., 2002; Ruffman et al., 2002). Especially effective are references to mental states within contrastive statements, such as "She thought she knew, but she didn't" (Lohmann & Tomasello, 2003; Symons et al., 2005; Tompkins, 2015). This kind of perspective-shifting discourse, in which subjective experiences are explicitly confronted with conflicting viewpoints or reality, helps children perceive the conflict and build the capacity to confront perspectives. Through these conversations, children also learn to make the right moves in language games that aim at predicting, explaining, and justifying misled actions, false judgments and seemingly baseless feelings by recourse to people's beliefs (e.g., "Maura is upset because she thought someone took her toy", when she simply overlooked it). In this way, children learn to see how seemingly irrational responses make sense from a person's subjective point of view. This is what Roessler and Perner (2013) have in mind when they state that young children come to put teleology in perspective by recognizing beliefs as reasons for action.

Just like jointly attending to and communicating about an object is important for infants to build a first, practical, level of understanding beliefs in interaction, jointly attending to and communicating about the alternative ways in which a state of affair might be represented, helps children to develop the theoretical awareness that one's view of the world is always cast in a particular perspective.

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