Are there signature limits in early theory of mind?

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Article history:
Received 15 June 2016
Revised 20 April 2017

Keywords:
Theory of mind
Two-systems theory
Signature limits
Social cognition
Implicit vs. explicit
Nativism

Abstract
Current theory-of-mind research faces the challenge of reconciling two sets of seemingly incompatible findings: Whereas children come to solve explicit verbal false belief (FB) tasks from around 4 years of age, recent studies with various less explicit measures such as looking time, anticipatory looking, and spontaneous behavior suggest that even infants can succeed on some FB tasks. In response to this tension, two-systems theories propose to distinguish between an early-developing system, tracking simple forms of mental states, and a later-developing system, based on fully developed concepts of belief and other propositional attitudes. One prediction of such theories is that the early-developing system has signature limits concerning aspectuality. We tested this prediction in two experiments. The first experiment showed (in line with previous findings) that 2- and 3-year-olds take into account a protagonist’s true or false belief about the location of an object in their active helping behavior. In contrast, toddlers’ helping behavior did not differentiate between true and false belief conditions when the protagonist’s belief essentially involved aspectuality. Experiment 2 replicated these findings with a more stringent method designed to rule out more parsimonious explanations. Taken together, the current findings are compatible with the possibility that early theory-of-mind reasoning is subject to signature limits as predicted by the two-systems account.

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Introduction

Current theory-of-mind (ToM) research faces what has been termed the “puzzle of belief reasoning” (Helming, Strickland, & Jacob, 2014). On the one hand, decades of research with a variety of mostly verbal false belief (FB) tasks suggest that children acquire the competence to ascribe beliefs at around 4 years of age (for a review, see the meta-analysis of Wellman, Cross, & Watson, 2001). Numerous findings indicate that the emergence of this competence is not a local phenomenon affecting performance on one or two isolated tasks. Instead, the competence reveals itself in systematically intercorrelated ways on a range of superficially diverse tasks where the common denominator of these tasks is merely that they require an understanding of representation (for a review, see Perner & Roessler, 2012). Thus, this development seems to be best described as a conceptual revolution; it is the novel acquisition of a comprehensive and unitary cognitive capacity.

But a rapidly growing body of new evidence suggests that infants and toddlers perform competently on implicit FB tasks well before 4 years of age (for reviews, see Baillargeon, Scott, & Bian, 2016; Baillargeon, Scott, & He, 2010). Violation-of-expectation tasks have found that infants look longer at events in which a protagonist acts in a way that does not fit her beliefs (e.g., Onishi & Baillargeon, 2005; Surian, Caldi, & Sperber, 2007). Anticipatory looking studies have shown that, from the second year of life or earlier, children—just like adults—look in anticipation to where an actor is going to act based on her beliefs (Clements & Perner, 1994; Rubio-Fernández, 2013; Schneider, Bayliss, Becker, & Dux, 2012; Southgate, Senju, & Csibra, 2007). Studies with interactive measures have shown that infants and toddlers can spontaneously help and inform others in ways that are sensitive to the recipient’s beliefs (Buttelmann, Carpenter, & Tomasello, 2009; Buttelmann, Over, Carpenter, & Tomasello, 2014; Knudsen & Liszkowski, 2012; Southgate, Chevallier, & Csibra, 2010).

Three competing accounts of early implicit ToM findings

How can these two seemingly incompatible sets of findings be reconciled? Three main theoretical responses to this puzzle of belief reasoning are currently under discussion. Late competence accounts claim that proper ToM capacities are required only for solving explicit tasks, whereas the new implicit tasks using looking time and interaction measures reflect much simpler cognitive capacities (Heyes, 2014; Ruffman & Perner, 2005; Sirois & Jackson, 2007). According to such accounts, many of the looking time studies can be explained by low-level processes such as a novelty preference (Heyes, 2014) or the use of simple behavior rules (Ruffman & Perner, 2005).

Early competence accounts argue the converse. According to these accounts, implicit tasks are the true indicator of ToM capacities. Younger children’s failures on explicit FB tasks do not reflect a deficit in ToM but merely reflect extraneous demands imposed by these tasks. These demands are extraneous in the sense that they have nothing to do with ToM per se but only with linguistic and other aspects of the explicit task structure (Baillargeon et al., 2010; Carruthers, 2013; Leslie, 2005).

Two-systems accounts oppose both late and early competence accounts. Instead, they claim, implicit tasks do tap ToM abilities of some kind, but these precocious abilities are distinct from the later-developing conceptual capacities measured in explicit tasks (e.g., Apperly & Butterfill, 2009; Low, Apperly, Butterfill, & Rakoczy, 2016; Perner & Roessler, 2012; Rakoczy, 2012). On such views, younger children’s failure on explicit FB tasks is not merely a consequence of extraneous demands but reflects a true conceptual deficit.

On a particularly promising two-systems account (Apperly & Butterfill, 2009; Butterfill & Apperly, 2013; Low et al., 2016), there are at least two systems for tracking beliefs and other mental states, which we label S1 (System 1) and S2 (System 2) in this article. Relative to S2, S1 trades flexibility for gains in efficiency by relying on a simpler model of mental states. Therefore, S1 is limited in ways that S2 is not. For our purposes, the crucial limit is that S1 does not enable tracking false beliefs essentially involving aspectuality. To illustrate aspectuality, consider a popular film. Lois Lane is yet to discover that Clark Kent is Superman. She simultaneously believes that Superman is with her and that Clark is elsewhere. She has incompatible beliefs about one and the same person under two different aspects. Only S2 is capable of tracking Lois’s beliefs, which essentially involve aspectuality. Suppose...
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