The curious case of adults' interpretations of violation-of-expectation false belief scenarios

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ABSTRACT

The interpretations of infants' non-verbal responses in violation-of-expectation (VOE) false belief scenarios are subject to intense theoretical debate. In Experiment 1, adults provided online narratives for VOE scenarios meant to tap understanding of false beliefs about object location, perception and identity. Adults provided cognitively-oriented narratives for the location scenario when instructed to track beliefs and, for this scenario only, participants evaluated the unexpected outcome as unexpected and the expected outcome as expected. Adults had mixed views about the perception scenario, and judged the identity scenario where the agent acted in violation of his belief as being reasonable. Experiment 2 confirmed that when the identity scenario was turned into an action task that was time-pressured, adults failed to act in a belief-based manner. We should be cautious in drawing firm conclusions about mentalizing in infancy when adults' narratives and estimates of the expectedness of outcome events suggest that only certain VOE scenarios were interpreted in their intended fashion.

1. Introduction

Decades of research on standard false belief tasks requiring verbal reasoning, indicate that theory-of-mind (TOM; also referred to as mindreading) emerges in humans from about 4 years of age (Wellman, Cross, & Watson, 2001). This basic developmental trend is illustrated in Wimmer and Perner's (1983) object location false belief task, in which Maxi is shown storing his chocolate in a cupboard and leaving the scene. During Maxi's absence, his mother transfers the chocolate to a table drawer. Children are directly asked to predict where Maxi will go to look for his chocolate. Most 3-year-olds incorrectly answer that Maxi will look in the actual location rather than in the place he left it. From age 4, children typically arrive at the correct answer, appreciating that others may have false beliefs about an object's location. From this age TOM is conceptually unified: the emerging understanding of belief includes not just the possibility for beliefs to misrepresent the world, but that people's beliefs can be about specific aspects of things (Rakoczy, Bergfeld, Schwarz, & Fizke, 2015). The classical view is that there is deep conceptual change in children's belief reasoning over the preschool years, and advances in language, executive function and participation in complex and diverse social interactions help children learn about subjective mental perspectives (Apperly, 2011; Low & Perner, 2012; Perner, 1991).

A challenge to the conceptual shift account comes from research using the violation-of-expectation (VOE) technique where the amount of time infants look at different stimuli is measured. Onishi and Baillargeon (2005) showed 15-month-olds scenarios of an agent forming either a true belief or false belief about an object's location. The agent was ultimately shown searching in the belief-compatible or the belief-incompatible location for the target object. Infants looked longer when the agent searched in a location that did not match her belief. Onishi and Baillargeon interpreted the longer looking as evidence of infants understanding that others act on

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the basis of their beliefs and that these beliefs are representations that may or may not correspond with reality.

In a follow-up study, Song and Baillargeon (2008) showed 14.5-month-olds an event sequence where an agent displayed a preference to reach for a black skunk instead of a blue-haired doll (skunk condition; toys' locations were counterbalanced). In the agent's absence, the skunk was put into a plain box and the doll was put into a box which had a black tail attached to the inner edge of its lid. The agent returned and was shown either reaching for the tail box or the plain box. Infants looked longer when the agent was shown reaching for the plain box, suggesting that 14.5-month-olds can track others' false beliefs based on the way an object appears. Other studies suggest that infants can even causally and systematically reason about others' beliefs. Scott and Baillargeon (2009) showed 18-month-olds an agent who was presented with a 2-piece penguin toy and a solid penguin toy. The agent repeatedly took out a key and hid it inside the 2-piece toy. When the agent was away, the 2-piece toy was assembled (to match the appearance of the one-piece penguin) and a transparent box was placed over it. An opaque box was placed over the indivisible toy so that the agent, on her return, would mistakenly believe that the observable penguin was the indivisible one. Then the agent, with key in hand, was shown to either reach for the transparent box or the opaque box. Infants looked longer when the agent reached for the transparent box than when the agent reached for the opaque box. The pattern of looking responses was taken to show that infants: inferred the agent's goal of hiding the key in the divisible toy; attributed that the agent falsely believed that the toy in the transparent box was the indivisible toy (when it was really the divisible toy); falsely believed that the divisible toy was located in the opaque box (when it was really in the transparent box); and expected the agent to reach for the opaque box and were surprised when she reached for the transparent box.

How can infants display sensitivity to others' false beliefs when responding in some ways while 3-year-olds treat false belief as impossible when responding to the very same situation in other ways? Baillargeon et al. (2010) explain that VOE techniques only tap the early developing psychological reasoning system and infants can simply express their abstract understanding of an agent's mental states as they observe a scene unfold. By contrast, standard TOM tasks make demands on language and executive function skills that develop slowly toward the end of the preschool years. These additional demands mask 3-year-olds' conceptual competency. There are, however, significant challenges to Baillargeon's argument (Sodian, 2011, 2016). First, children's executive function is correlated uniformly with performance on TOM tasks that impose high or low executive demands (Carlson, Claxton, & Moses, 2015). Moreover, preschoolers with a high level of executive function skills pass standard false belief tasks at the same time as their control counterparts (Sabbagh et al., 2006). Second, infants' responses to VOE tasks can just as well be explained by differential attention to the perceptual novelty of certain test outcomes with respect to previously encoded events (Heyes, 2014) or to the following of stimulus-response behavior rules (Ruffman, 2014). Finally, the combined evidence of success amongst infants in diverse VOE studies is largely based on data between age groups and between children, making it difficult to compare depth of understanding on indirect versus direct measures of false belief reasoning (Yott & Poulin-DuBois, 2016).

VOE methodology is primarily designed to answer questions about infants' basic sensory discriminations (Haith, 1998); higher-level explanations of how the unexpected and expected event sequences are meant to be interpreted in the VOE studies are provided by the researchers themselves.

Scott and Baillargeon (2009) construe their VOE scenario as engaging infants' understanding of false beliefs about object identity. Others disagree with the interpretation (e.g., Butterfill & Apperly, 2013; Fizke, Butterfill, van de Loo, Reindl, & Rakoczy, 2017; Low, Apperly, Butterfill, & Rakoczy, 2016; Ruffman, 2014; Wellman, 2014; Zawidzki, 2013) and suggested that the scenario only taps tracking of others' false beliefs involving the types of objects present and not object identity. An agent's false belief over object identity, in the strict numerical sense, would result in mistakes involving expansion (agent thinks that there are two distinct objects when there is only one) or mistakes involving compression (agent thinks that there is only one object when there are two). Butterfill and Apperly argued that in the case of Scott and Baillargeon's task, there were always two objects present on the stage (a divisible penguin and an indivisible penguin) and the agent possessed the same knowledge. Infants could have passed the task by tracking the agent's false belief of the types of objects present: the object on that side is a divisible toy so the object on the other side is an indivisible toy.

To shed light on the debate over the interpretation of infants' responses in VOE studies, the current research asks whether adult participants would explain VOE event scenarios in the same way that was intended by the task developers themselves. If adults find it difficult to grasp the event sequences that make up complex VOE tasks, it would be difficult to sustain a rich mentalistic interpretation of infants' looking behavior on the same tasks. In Experiment 1, we examined adults' explanatory narrations for false belief VOE scenarios that have been used in three prominent infant studies. In Experiment 2, we measured adults' non-verbal reaching actions to assess the construct validity of a VOE scenario that has been suggested to involve false beliefs about object identity.

2. Experiment 1

2.1. Method

In Experiment 1 adults provided online narratives for three VOE films that have been suggested to involve an agent's false belief about: object location (Onishi & Baillargeon, 2005), object perception (Song & Baillargeon, 2008) and object identity (Scott & Baillargeon, 2009). At the end of each film, participants saw either an expected ending (the agent acted in a way that was consistent with his false belief) or an unexpected ending (the agent acted in a way that was inconsistent with his false belief). We expected that adults would be able to explain and make sense of the object location and object perception false belief VOE scenarios, but that there would be ambiguity over the meaning of the object identity VOE scenario.

We also compared adults' narrations and judgments depending on whether participants were instructed to watch the VOE films