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The influence of a bystander agent's beliefs on children's and adults' decision-making process

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ABSTRACT

The ability to attribute and represent others' mental states (e.g., beliefs; so-called "theory of mind") is essential for participation in human social interaction. Despite a considerable body of research using tasks in which protagonists in the participants' attentional focus held false or true beliefs, the question of automatic belief attribution to bystander agents has received little attention. In the current study, we presented adults and 6-year-olds ($N = 92$) with an implicit computer-based avoidance false-belief task in which participants were asked to place an object into one of three boxes. While doing so, we manipulated the beliefs of an irrelevant human-like or non-human-like bystander agent who was visible on the screen. Importantly, the bystander agent's beliefs were irrelevant for solving the task. Still, children's decision making was significantly influenced by the bystander agent's beliefs even if this was a non-human-like self-propelled object. Such an influence did not become obvious in adults' deliberate decisions but occurred only in their reaction times, which suggests that they also processed the bystander agent's beliefs but were able to suppress the influence of such beliefs on their behavior regulation. The results of a control study ($N = 53$) ruled out low-level explanations and confirmed that self-propelledness of agents is a necessary factor for belief attribution to occur. Thus, not only do humans spontaneously ascribe beliefs to self-propelled bystander agents, but those beliefs even influence meaningful decisions in children.

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Introduction

Humans are unique in their social cognition, as demonstrated by acts such as their ability to learn from others and their natural tendency to collaborate. To explain or predict others' behavior in such acts, it is necessary to pay attention not only to observable states of the world but also to others' mental states (e.g., intentions, beliefs, desires) because humans do not act based on reality but rather act based on their representations of reality. This ability (the so-called "theory of mind"; Premack & Woodruff, 1978) is suggested to be the driving force behind humans' uniquely sophisticated social structure (Kovács, Téglás, & Endress, 2010).

Previous studies, designed to measure participants' understanding of a protagonist's mental states directly, focused mainly on the question of when theory of mind develops ontogenetically, especially the understanding of others' false beliefs. In the standard task for measuring children's understanding of others' beliefs, children are told a story about a female protagonist who puts an object into a box. In her absence, this object is moved to another box, resulting in the protagonist holding a false belief about the object's location. When children are asked where the protagonist will search for the object on her return, they do not answer correctly (i.e., that the protagonist will look for the object where she falsely believes it to be) before the age of 4 or 5 years (Wimmer & Perner, 1983; see Wellman, Cross, & Watson, 2001, for a review). However, recent studies measuring participants' looking behavior (e.g., Baillargeon, Scott, & He, 2010; Onishi & Baillargeon, 2005; Scott & Baillargeon, 2009) or active helping (e.g., Buttelmann, Carpenter, & Tomasello, 2009; Buttelmann, Over, Carpenter, & Tomasello, 2014; Buttelmann, Suhrke, & Buttelmann, 2015; Southgate, Senju, & Csibra, 2007) demonstrated false-belief understanding even in 1-year-olds.

Theoretical accounts on the attribution of goals and intentions (Sperber & Wilson, 2002) and beliefs (Baron-Cohen, 1995; Carruthers, 2015) suggest that humans automatically ascribe mental states to others. Recent studies providing empirical support for these accounts present participants with tasks in which they need to perform a specific action (e.g., pressing a button when an object appears, indicating where an object is hidden) while—irrelevant to the task—a bystander agent is present or absent during stimulus presentation. Automatic processing would become evident if participants' performance was influenced by the bystander agent's perception and representations. Indeed, those studies revealed that adults and children automatically track a bystander's perceptions (Samson, Apperly, Braithwaite, Andrews, & Bodley Scott, 2010; Surtees & Apperly, 2012) and even beliefs (Kovács, Kuehn, Gergely, Csibra, & Brass, 2014; Kovács et al., 2010; Schneider, Nott, & Dux, 2014; Van der Wel, Sebanz, & Knoblich, 2014). For example, in the go/no-go task by Kovács and colleagues (2010), adults watched a ball disappear behind an opaque barrier. This ball sometimes changed its location by appearing and disappearing behind the barrier again or by appearing and leaving the scene. Some of the ball's movements were observed by an irrelevant human-like agent, so that this agent held a true or false belief about whether or not there was a ball behind the barrier. For the test phase, the barrier disappeared. The adults' task was to press a button as quickly as possible when a ball was present behind this disappeared barrier. The findings show that the participants' reaction times were influenced by the human-like agent's beliefs despite these beliefs' irrelevance at solving the task (e.g., they responded faster when a ball was present even though they had not expected it if the agent falsely had expected one, compared with when both they and the agent had not expected to find a ball). This tendency appears to have its origins early in ontogeny; even infants' looking times were influenced by the irrelevant agent's beliefs in the very same task, which suggests that the underlying mental-state tracking mechanism operates automatically, possibly from birth onward.

In contrast to the considerable body of research on theory of mind using human-like protagonists, only a few studies used non-human-like protagonists to investigate the range of mental-state ascription in humans. These studies show that when presented with contingently moving inanimate geometric objects, children and adults have a tendency to describe what they observed similarly to how they would describe a human-like protagonist's behavior, ascribing emotions and intentions to these objects (Heider & Simmel, 1944; Luo & Baillargeon, 2005; Montgomery & Montgomery, 1999). The first hint that humans already attribute beliefs during infancy even to such non-human-