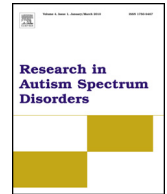




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Competition enhances mentalizing performance in autism



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ABSTRACT

This study examines the independent effects of competition, engagement, and reward on false belief performance in children with autism. Twenty-eight 8- to 15-year-olds (mean age = 12 years) with autism were tested on a modified version of the Sally–Anne task and the Dot–Midge task in Experiment 1. In Experiment 2 we recruited thirty 8- to 16-year-olds (mean age = 12 years) with autism who were tested on the Dot–Midge task and two further versions of the Sally–Anne task comprising a reward and a reward+engagement component, respectively. Comparing the children’s performances on these tasks therefore sheds light on the relative importance of competition, engagement, and reward in their application of false belief knowledge. Nonverbal intelligence and vocabulary were also measured as covariates. The participants performed significantly better on the Dot–Midge task than all the different versions of the Sally–Anne task in the two experiments, whereas the different versions of the Sally–Anne task did not differ among themselves. The effect of task did not interact with the covariates. This result suggests a unique role of competition in the use of false beliefs in children with autism, complementing the work by [Peterson, Slaughter, Peterson, and Premack \(2013\)](#) which highlights the importance of social motivation.

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1. Introduction

In the literature different types of cognitive impairment have been used to account for the social deficits observed in children with Autistic Spectrum Disorder (ASD). For instance, problems in central coherence ([Happe, 1994](#)), executive functioning ([Russell, 1997](#)), and mentalizing, or theory of mind (ToM; [Baron-Cohen, 1989](#); [Tager-Flusberg, 1999](#)), are put forward as explanations for ASD. False belief, or the understanding that others can possess wrong thoughts which guide their behavior, has been regarded as the most representative sub-ability of ToM and thus may correlate significantly with ASD. In fact, children with autism have consistently been shown to fail standard false belief tasks; yet interestingly if adequate social motivation is induced they could actually pass these tasks ([Peterson et al., 2013](#); [Senju, Southgate, White, & Frith, 2009](#)). Hence social motivation may enhance mentalizing and facilitate its expression in children with autism. In this paper, we argue that increased social motivation under a competitive task context promotes autistic children’s false belief performance.

To interact with others efficiently, it is crucial to deploy ToM and infer their mental states from time to time so that subsequent behavior can be planned to maintain social connection in an appropriate way. The ToM theory of autism stipulates that individuals with autism lack social cognition and find it difficult to mentalize and infer others’ mental states,

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resulting in a corresponding lack of motivation to interact with others (Baron-Cohen, 2001). Such impoverished interaction leads to further loneliness and social detachment (Bauminger, Shulman, & Agam, 2003; White & Roberson-Nay, 2009). According to this view, what causes social deficits is impaired cognition, and low social motivation is seen more as an accompanying result. Given the supposed importance of ToM, various tests have been devised to assess it in individuals with autism. For example, the seeing-leads-to-knowing task (Baron-Cohen & Goodhart, 1994) is based on the principle that people know things which they have experienced. Individuals with autism however may not adequately grasp this concept and communicate what others or they themselves do not know. Tests on spontaneous pretense play have found that individuals with autism generally display lower performance levels of such play than normal controls (Lewis & Boucher, 1988). Their weaker ability to deploy imagination in pretense may also indicate a mindreading deficit (Leslie, 1987). In this regard, the Sally–Anne task has been frequently used to highlight the specificity of autism in its incompetence to impute mental states to oneself and to others (Baron-Cohen, Leslie, & Frith, 1985). In this task a story is told to the child, in which Sally puts a ball into a basket and leaves the room. While she is away Anne moves the ball from the basket into a box, which Sally does not see. The child is asked where Sally would first look for the ball when she comes back. Individuals with autism may fail the task by using their own knowledge of the whereabouts of the ball, instead of Sally's false belief, to predict her subsequent action. While typically developing children at the age of 3 or 4 would pass this task (Wimmer & Perner, 1983), on average a verbal mental age of 9 is expected for children with autism to achieve a comparable level of performance (Happe, 1995). On the one hand, the mentalistic nature of the task has been specified as an explanation for why children with autism perform poorly (e.g., Leekam & Perner, 1991; Peterson, Garnett, Kelly, & Attwood, 2009; Zaitchik, 1990); on the other hand, social motivation has been shown to improve the performance of this task in ASD children (Peterson et al., 2013; Senju et al., 2009).

Unlike the ToM theory which considers the lack of social interest as a consequence of cognitive deficits, the social motivation theory views the lack of social interest as a cause that leads to apparent cognitive impairment in autism (Chevallier, Kohls, Troiani, Brodtkin, & Schultz, 2012). Hence it is expected that social cognition performance can be improved by enhancing social motivation. According to Chevallier et al. (2012), social motivation is sustained through social orienting, social reward, and social maintaining. Although these three aspects are assumed to be dispositionally disrupted in individuals with autism (Klin, 1991; Leekam & Ramsden, 2006; Riby & Hancock, 2008), experimental manipulations of them in some previous studies have been shown to promote social-cognitive task performances in ASD individuals. For instance, Senju et al. (2009) found that although adults with autism could not spontaneously interpret others' beliefs as indicated by their natural gaze directions, they could answer false belief justification questions correctly under explicit instruction. Similarly, relatively low brain activities in the medial prefrontal cortex and right superior temporal gyrus were found in children with autism in perceiving ironic scenarios, yet explicit instruction asking them to focus on facial expressions and tones of voice was effective in modulating such brain activities (Wang, Lee, Sigman, & Dapretto, 2007). Therefore individuals with autism appear to be capable of mentalizing; whether they would choose to do so depends on how they are motivated to attend to the relevant stimuli.

To examine how the social motivation and ToM theory may complement each other in explaining autism, the standard Sally–Anne false belief task has been modified to include a competition component for higher social motivation. In this regard, Peterson et al. (2013) devise the Dot–Midge task in which participants need to compete with a live opponent for a desired prize. The experimenter and the participating child first put the prize into a box while Dot and Midge observe. Dot then leaves the room. In Midge's presence, the experimenter retrieves the prize and puts it into another box; Midge then leaves. Upon Dot's and Midge's return, the child is asked 'Who should open the box?', knowing that whoever discovering the prize will get it. To obtain the prize him/herself, the child should opt for Dot who holds a false belief about prize location. According to Peterson et al. (2013), the much higher average passing rate in this task (74%), compared to the motivationally barren Sally–Anne task (13%), suggests that children with autism could infer others' mind content when motivated by a competitive context in which a reward is available.

Three motivational components can actually be identified in the Dot–Midge task. First, the participating child needs to compete with an adversary because there is only one individual who can get the prize. Second, the child is more engaged in the task because he/she is invited to transfer the prize together with the experimenter and given the freedom to choose his/her adversary. Third, a desired reward is available. It is not clear which of these components are responsible for the heightened passing rates observed in children with autism. In other words, what aspects of social motivation are most relevant to enhancing social cognition performance in these children?

Competition is social in nature. It provides a context in which one's decision or action is referenced in relation to its consequence on others. A meta-analysis on the general impact of competition by Stanne, Johnson, and Johnson (1999) has revealed that individuals perform better when competing with others than working on their own, and a high achievement orientation to surpass opponents raises the intrinsic motivation to compete. When motivated to surpass others in a competitive context, individuals orient themselves toward performing certain goal-directed behaviors. In a running competition for instance, the goal-directed behavior in question would be to run faster than the competitors. In this context the sheer idea of winning and beating others, regardless of the availability of prizes, already constitutes a sense of competition that induces motivation. Hence, the motivational effects associated with competition and reward should be considered and examined separately in understanding their roles in mentalizing in autism.

In the Dot–Midge task, competition is communicated through the presence of the competitors Dot and Midge. How participants acknowledge the competitive context is influenced by their perception of the competitors. Geurts, Luman, and

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