



# The relationship between joint attention and theory of mind in neurotypical adults

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## ABSTRACT

Joint attention (JA) is hypothesized to have a close relationship with developing theory of mind (ToM) capabilities. We tested the co-occurrence of ToM and JA in social interactions between adults with no reported history of psychiatric illness or neurodevelopmental disorders. Participants engaged in an experimental task that encouraged nonverbal communication, including JA, and also ToM activity. We adapted an in-lab variant of experience sampling methods (Bryant et al., 2013) to measure ToM during JA based on participants' subjective reports of their thoughts while performing the task. This experiment successfully elicited instances of JA in 17/20 dyads. We compared participants' thought contents during episodes of JA and non-JA. Our results suggest that, in adults, JA and ToM may occur independently.

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## 1. Introduction

Joint attention (JA) can be defined as the coordination of orienting between two people toward an object (Emery, Lorincz, Perrett, Oram, & Baker, 1997; Kristen, Sodian, Thoermer, & Perst, 2011; Moore & Dunham, 1995; Mundy & Newell, 2007; Scaife & Bruner, 1975). JA solidifies between 6 and 18 months of age in typically developing children and can be split into two main phases: initiation of joint attention (IJA) and response to joint attention (RJA) (Bruinsma, Koegel, & Koegel, 2004; Mundy et al., 2007). For example, a parent may initiate JA by pointing to an object, and their child may respond by shifting their gaze to follow the parent's point.

While JA is defined in terms of *observable human behavior*, theory of mind (ToM) involves the attribution of *unobservable mental states* (Malle & Knobe, 1997; Povinelli & Vonk, 2004). People capable of deploying ToM have the ability to think and reason about their own or another person's mental states, which include thoughts, beliefs, intentions, and/or desires (Malle, 2005, 2013; Premack & Woodruff, 1978; Wellman, Cross, & Watson, 2001).

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Several lines of research have led to four main hypothesized relationships between ToM and JA across human development. First, the emergence of JA skills may scaffold the later consolidation of ToM in typically developing children (Charman et al., 2000; Kristen et al., 2011; Moore & Dunham, 1995; Nelson, Adamson, & Bakeman, 2008; Roeyers, Van Oost, & Bothuyne, 1998). This conjecture follows a parallel premise in evolutionary and comparative psychology: JA may have been necessary for the eventual evolution of ToM in humans (Malle, 2002). JA behaviors have been experimentally observed in non-human animals, including chimpanzees (Povinelli & Eddy, 1996, 1997; Povinelli, Theall, Reaux, & Dunphy-Lelii, 2003; Tomasello, Hare, & Agnetta, 1999; Watts, 2002), other primates (Tomasello, Call, & Hare, 1998), ungulates (Kaminski, Riedel, Call, & Tomasello, 2005), and various bird species (Bugnyar, Stowe, & Heinrich, 2004; Loretto, Schloegl, & Bugnyar, 2010; Schoegl, Kotrschal, & Bugnyar, 2007). Although we believe there is no compelling evidence for ToM in non-human animals (Penn & Povinelli, 2007; Povinelli & Giambrone, 1999; Povinelli & Vonk, 2004), this is controversial, with many, if not most, groups in disagreement (Krupenye, Kano, Hirata, Call, & Tomasello, 2016; Tomasello & Call, 2006; Tomasello, Call, & Hare, 2003a,b).

Second, and contrary to the first hypothesis, some investigators have argued that the presence of ToM, or ToM-like behaviors, may be necessary in order to drive the development of JA (Tomasello, 1995; Tomasello, Carpenter, Call, Behne, & Moll, 2005). This would imply that ToM takes developmental primacy over JA.

Third, regardless of primacy in early typical development, JA and ToM are often thought to co-occur (Tomasello, Carpenter, & Liszkowski, 2007). According to this view, when one person orients another person to an object, or one responds to such an invitation, one or both partners are necessarily thinking about their own or the other's mental states. For example, the aforementioned orienting event might involve a person wanting the other to *share the experience* of watching an interesting video, or a child wondering what their parent *thinks* about a toy (see also Moore & Dunham, 1995).

Fourth, and finally, at an undefined point in development, JA and ToM may not systematically co-occur, because of the complex evolutionary relationship between the two systems (see Povinelli & Giambrone, 1999).<sup>2</sup> In this context, it is worth noting that few researchers have attempted to measure ToM occurrences during social interaction, and while some have found that overt ToM processes may be relatively uncommon during social interactions among adults (Bryant, Coffey, Povinelli, & Pruett, 2013), other studies found that such processes make up about one third of the thoughts about an interaction partner (Malle & Pearce, 2001). Most important, little research has attempted to quantify the co-occurrence of JA behaviors and ToM processes, and their relationship therefore remains poorly understood and experimentally underexplored.

Impaired JA is a primary, characteristic feature of Autism Spectrum Disorder (ASD) (Bruinsma et al., 2004), which may contribute to differences in language development and social behavior in individuals with ASD (Volkmar, Lord, Bailey, Schultz, & Klin, 2004). Children with ASD often also demonstrate lowered ToM capabilities (Baron-Cohen, 2000; Volkmar et al., 2004). Understanding better the continuities or discontinuities for the typical relationship between JA and ToM might, therefore, inform the refinement of effective joint attention-based interventions for individuals with ASD (Kasari, Freeman, & Paparella, 2006; Kasari, Gulsrud, Freeman, Paparella, & Hellemann, 2012).

Therefore, with this study, we aimed to (1) test the widely held assumption that ToM and JA naturally or normally co-occur, working with a sample of neurotypical adult humans who could give subjective reports of their thoughts, and (2) to establish methods that could, in the future, be adapted to test aspects of the third major aforementioned hypothesis in typically and atypically developing children. By directly testing for the association between operationally-defined occurrences of ToM and JA, we were able to measure the relative frequencies of mental state attributions during JA as compared to non-JA behaviors and, consequently, begin to answer the question of whether thinking about another adult's mental states is necessary for participation in JA.

## 2. Materials and methods

### 2.1. Participants

We recruited study participants through Washington University Volunteers for Health and word of mouth. Participants included 40 adults, aged 18–35 (mean age = 24.1, *SD* = 3.7), with no reported history of neuropsychiatric disorders and no family history of Autism Spectrum Disorder (ASD) or Attention-Deficit/Hyperactivity Disorder (ADHD). We compensated participants based on the length of their participation. The study was approved by the Washington University Human Research Protection Office.

### 2.2. Setup and procedure

Participants were scheduled to complete the experiment in pairs. After both individuals arrived, we brought them to a waiting room in our lab. We obtained informed consent from each participant separately.

<sup>2</sup> One account of such an evolutionary dissociation between ToM and JA is the reinterpretation hypothesis (see Povinelli & Giambrone, 1999). This model suggests that the evolution of complex social behaviors was not initially caused or accompanied by the evolution of ToM. Rather, the human ability to reinterpret behavior in terms of mental states evolved uniquely in the human lineage and in a way that did not initially drastically alter the basic social behaviors themselves.

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