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I've got your number: Spontaneous perspective-taking in an interactive task

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ABSTRACT

Thinking about how other people represent objects in the world around them is thought to require deliberate effort. In recent years, interactive "joint action" paradigms have shown how social context can affect our cognitive processing. We tested whether people would represent their partner's point of view in a simple team game. Participants played a game in which they had to judge the magnitude of a number either sat alone, or opposite a partner. Importantly they were never asked to judge their partner's point of view. Remarkably, when playing the game as a team, people were better when their partner happened to share their view of the number, such as when seeing a number 8, than when their partner viewed the number to be different, such as when seeing a number 6 that looked like a number 9 to their partner. In two further experiments, we identified the conditions under which the effect was present. Experiment two showed that the effect was only present after observing the prior involvement of one's partner in the task. Experiment 3, showed that the aspect of the stimulus (its magnitude) that participants were sensitive to did not need to be the aspect of the stimulus to which their partner was paying attention.

1. Introduction

Human beings have evolved to live in complex social worlds and we rely on our ability to cooperate to achieve common goals (Tomasello, 2008). We are naturally predisposed towards teaching and learning important information from others (Csibra & Gergely, 2009) and show continued sensitivity to their belief-like states from infancy (Kovacs, Teglas, & Endress, 2010; Onishi & Baillargeon, 2005; Schneider, Bayliss, Becker, & Dux, 2012). These propositions imply a sensitivity to the points of view of other people, which under some circumstances may be detrimental to focusing on our own perspective. Research on joint action has focussed on how we incorporate another's goals with our own (Sebanz, Knoblich, & Prinz, 2003). Research on perspective-taking has focussed on how we represent the perspectives of others when they are different from our own (Flavell, Everett, Croft, & Flavell, 1981; Keysar, Lin, & Barr, 2003; Samson, Apperly, Braithwaite, Andrews, & Scott, 2010). In this paper, we combine these strands and use an interactive task to test whether we compute other people's perspectives even when there is no explicit goal to do so. The rationale behind this is that if joint task contexts predispose us to be aware of other people's perspectives, it should affect us *regardless* of whether we have an explicit goal to take into account how they see the world.

1.1. Perspective-taking

Even if two people jointly attend to a single object, they may see the object in different ways (Piaget & Inhelder, 1956). Developmental psychologists consider this to be level-2 perspective-taking, as distinct from level-1 perspective taking, which is the ability to know if another person can see a given object or not (Flavell et al., 1981; Masangkay et al., 1974). The distinction between level-1 and level-2 perspective-taking has regularly been proposed to mark a significant landmark in our perspective-taking abilities (Apperly & Butterfill, 2009; Flavell et al., 1981; Surtees, Apperly & Samson, 2016; Surtees, Butterfill, & Apperly, 2012). Children's level-2 perspective-taking develops relatively late, at around the age of 4 (Flavell et al., 1981; Masangkay et al., 1974). Interestingly, level-2 abilities develop at the same age at which children first begin to understand about false beliefs on standard tasks (Wimmer & Perner, 1983) and the difference between appearance

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and reality (Flavell, 1986). Level-2 perspective-taking has yet to be shown in non-human animals (Call & Tomasello, 2008), adding further weight to the notion of it being a cognitively effortful activity, or requiring complex concepts. In two previous studies, we tested whether children and adults automatically take other people's level-2 perspectives (Surtees et al., 2012; Surtees et al., 2016). When presented with stimuli of an avatar in a room, children and adults showed no systematic detrimental effect in self-perspective performance when the avatar saw a numeral to be different to how they, themselves, saw it (for example a 6 which appears as a 9 for the avatar; Surtees et al., 2012). This contrasts with findings from level-1 perspective-taking, which show children and adults to be automatically influenced by how many objects an avatar can see when making judgements about how many objects they, themselves, can see (Samson et al., 2010; Surtees & Apperly, 2012). This suggests that level-2 perspective-taking requires controlled processing, using executive resources (Surtees et al., 2012). However, even if level-2 perspective-taking is not automatic, and requires costly executive resources, people clearly do engage in this form of perspective-taking when necessary. The current study looks at whether situations involving joint goals and joint attention provide sufficient circumstances for adults to adopt someone else's perspective spontaneously.

1.2. Social facilitation

Whilst developmental psychologists identified an inherent difficulty for individuals in explicitly judging the perspectives of other people, social psychologists have for more than a century identified ways in which people adapt their performance in the presence of others without any obvious reason for doing so (Triplett, 1897; Zajonc, 1965). In Triplett's (1897) seminal studies, the mere presence of another person was shown to cause participants to perform better than when they were alone. Such *facilitation* is not limited to humans, with rats (Zentall & Levine, 1972) and chickens (Tolman, 1967) actively pursuing food more persistently when in the presence of others, suggesting that this is not the result of higher order social reasoning. Social presence does not always improve performance; in fact it can directly hinder it. Individual performance has been shown to get worse (Social loafing) when it is evaluated on whether participants complete a joint goal or when they complete a more complex task (Aiello & Douthitt, 2001). The most influential explanation of this pattern of performance has been through Zajonc's (1965) proposal that social presence increases drive or arousal and that this improves performance of dominant actions and reduces performance of non-dominant actions. Alternative proposals have been that social presence facilities through behavioural imitation or mimicry (Cheng & Chartrand, 2003), through social comparison (Cottrell, 1972) or through cognitive appraisal (Baron, 1986). Whilst research on social facilitation has taken place for more than a hundred years, early interest failed to make a distinction between the effect of the presence of an audience and another active participant (Zajonc, 1965). Most relevantly to research on perspective-taking, social facilitation theories have tended to investigate solely the magnitude of performance, rather than whether social facilitation can prompt social understanding between people. As regards to this, recent research on joint action and joint attention has looked more specifically at how the goals and intentions of active partners can influence one another.

1.3. Joint action/perception

When people interact with others towards a common goal, they often perform differently to when they complete a task independently (Richardson, Dale, & Kirkham, 2007; Sebanz et al., 2003; Shteynberg & Galinsky, 2011; Spivey, 2007). Sebanz et al. (2003) demonstrated this in "the Social Simon effect". In a classic Simon task (Simon, 1969), people respond to a visual dimension of a stimulus (its colour) whilst ignoring the spatial dimension of the stimulus (its appearance on the left or right side of the screen). Participants are affected by the spatial dimension of the task when they make a left–right choice response, but not when they respond (go) to one colour and withhold a response (no-go) to the other. In the Social Simon, participants perform the go/no-go version of the Simon task with a partner, each responding to a different colour. In these conditions, the influence of the spatial dimension reappears, suggesting that people represent the goal of the task as a joint goal, rather than merely representing their own part of the task.

The effect of social interaction on cognitive and perceptual processing has also been noted when people engage in conversation. Richardson et al. (2007) and Richardson et al. (2012) have shown that individuals adjust their visual experience to maximise the common ground between them. Long a central component of social theories of language and communication (Clark, 1996; Sperber & Wilson, 1986), the pervasiveness of common ground has been challenged by work suggesting people don't have immediate access to the referents of others (Keysar et al., 2003). However, work examining the looking behaviour of adults has suggested a remarkable convergence between the eye gaze patterns of communication partners (Richardson & Dale, 2005). Groups of participants will look at a relevant individual when a stereotyped trait is mentioned by another communicator, but only if they believe that person can also hear the comment (Crosby, Monin, & Richardson, 2008). Similarly, people coincide in their eye gaze to well-known characters being described by a partner (Richardson & Dale, 2005). Shteynburg et al. have made similar progress in discerning how and when an individual will adapt their aims and goals to that of a similar other. Pairs of participants who believe that they have experienced instructions in common with similar others will learn to adapt their conversational style (Shteynberg & Apfelbaum, 2013) and will adjust their aims to a more cautious miss-reduction strategy or more speculative hit-maximisation strategy when they believe that a similar other has also received that instruction (Shteynberg & Galinsky, 2011). Shteynberg and colleagues' results (Shteynberg & Apfelbaum, 2013; Shteynberg & Galinsky, 2011) suggest that, not only do we look to minimise discrepancies between the experience of ourselves and similar others, but that we will actively adopt a strategy in common with a partner's even if we do not have a common goal. However, evidence that individuals look to increase common ground (Garrod & Pickering, 2009), maximise shared experience and adopt joint strategy and learning opportunities does not address the question of how people deal with situations in which ground, experience or strategy are not in common; that is to say, when partners differ in their perspectives. Thus, this literature also leads to the question of the conditions under which partners are sensitive to each other's perspectives.

Böckler, Knoblich, and Sebanz (2011), Böckler and Sebanz (2012) and Böckler and Zwickel (2012) extended the methods of joint action studies to consider joint perception. Böckler et al. (2011) presented participants with pictures of two hands sequentially. Participants were asked whether the second hand was the same (left or right) hand as the first. Crucially, for half of the trials (the alone condition), the partner closed their eyes. For the other half, they had their eyes open (the joint condition). When the second hand was 120–180° rotated away from the participant's own body orientation, performance was better in the joint than the alone condition. At 0–60° performance was better in the alone condition. This pattern suggested that participants were shifting towards more allocentric than egocentric encoding when another person was present. Joint perception has also been found to modulate neural activity; Böckler and Zwickel (2012) identified