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Pointing gestures help 2- to 4-year-olds solve, but not understand, invisible displacement problems

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ABSTRACT

Although recent work in developmental psychology has established that children understand communicative gestures at a very early age, few studies have examined whether social cues would help them in the spatial domain. The objective of this study was to investigate whether 2- to 4-year-old children use adults' pointing gestures to succeed and understand two complex invisible displacement problems that have not yet been mastered at this age: the spatial translation (Experiment 1) and the spatial rotation problems (Experiment 2). In both experiments, social and non-social conditions were administered. In the social condition, after the invisible displacement of an object to a new spatial position, an experimenter pointed the hiding location of the object. In the non-social condition, no pointing gestures were provided. The results of both experiments revealed that children use adults' pointing gestures over their own (but erroneous) spatial knowledge. Moreover, the results of Experiment 2 showed that social cues help children to succeed, but not to understand, invisible displacements of objects. In discussion, the limitations of using adults' pointing gestures to help children to develop an understanding of spatial problems as well as the reasons why children rely spontaneously on social communicative cues are explored.

Human children routinely engage in shared activities with others, such as joint attention, gestural communication, imitation and collaboration (Herrmann, Call, Hernàndez-Lloreda, Hare, & Tomasello, 2007; Tomasello & Rakoczy, 2003). Pointing gestures are regarded as one of the primary expressions of social cognition understood and used by children and adults to communicate with each other (Carpenter, 2010).

The procedure of choice used by researchers studying pointing comprehension in young children is the object search-choice task – an object is hidden beforehand inside one of two potential hiding locations, and an adult points to the actual hiding location. Although children as young as 12 months old appear to be able to solve the object search-choice task (Behne, Liszkowski, Carpenter, & Tomasello, 2012), the understanding of pointing gestures as communicative cues is not fully mastered before the age of 24 months (Behne, Carpenter, & Tomasello, 2005). Lakatos, Soproni, Dòka, and Miklòsi (2009) also revealed that 3-year-old children perform better in the object search-choice task with unfamiliar social cues

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(e.g. pointing with a knee or a leg) than 2-year-olds, suggesting a greater generalization of informative pointing gestures in older children.

Variations of the object search-choice task have also been used to further demonstrate the strong influence of adults' pointing gestures in children. For instance, Couillard and Woodward (1999) used a deceptive pointing task in which the experimenter pointed to the incorrect location instead of the correct one. The results revealed that 3- to 4-year-old children performed at chance level for 10 consecutive trials, suggesting that they have a difficulty inhibiting misleading pointing cues, reinforcing the view that pointing gestures given by an adult are extremely powerful in children. In a slightly different paradigm, Palmquist, Burns, and Jaswal (2012) showed that 3- to 4-year-old children searched equally at the location pointed to by someone who has relevant knowledge about the hiding location and the location pointed to by someone who does not. In both later studies, when pictures were used as cues instead of pointing gestures, children did not follow the misleading cue or the location indicated by the ignorant informant and succeeded in the task. These results suggest that adults' pointing gestures are so powerful that they can mask children's abilities to understand false beliefs and discriminate between knowledgeable and ignorant informants (Couillard & Woodward, 1999; Palmquist et al., 2012).

To our knowledge, however, only Moriguchi and Itakura (2005) have investigated how children use pointing gestures when dealing with conflicting information for finding an object they saw disappear (for a similar approach using verbal cues, see Ma & Ganea, 2010). For instance, would children rely on pointing gestures provided by an adult (social cues) or on their own direct observation of the location where they saw the object disappear (spatial cues)? To study this question, Moriguchi and Itakura (2005) used the Piagetian visible displacement task, which is easily mastered by 2-year-old children. In this study, an experimenter hid an attractive object inside one of the two cups placed in front of the child. After the disappearance of the object under one cup, the experimenter gave contradictory social cues about the location of the hidden object by pointing to the incorrect cup, putting into conflict the spatial knowledge of the child and the knowledge of the experimenter. Moriguchi and Itakura (2005) showed that both 2- and 3-year-olds search at the same frequency under the correct and the incorrect cups, suggesting that deceptive pointing gestures by an adult can conceal children's spatial abilities by interfering with the exact location of a hidden object.

In the current study, we further investigated the role of pointing gestures by adults on children's search behavior for disappearing objects when dealing with conflicting information. By contrast to Moriguchi and Itakura (2005), who used deceptive pointing gestures to investigate the influence of adults' pointing gestures on children's choice, we wanted to see if trustable gestures could help children to succeed on spatial problems that had not yet been mastered at a particular age. Since adults generally used pointing gestures to designate useful information to children, this later approach, reflecting a real-life situation, has far more ecological validity than the use of deceptive information. Moreover, this approach has the advantage of being similar to the object-choice task, which also relies on trustable communicative signals provided by an adult. On the other hand, by presenting young children with a spatial task that has not yet been mastered, we also wanted to investigate whether children can develop an understanding of these spatial problems via the use of an adult's informative pointing gestures. Indeed, given the importance of pointing gestures by adults as communicative signals for children, it may be possible that repeated exposures to adults' pointing gestures help children to develop over time an understanding of cognitive problems. For instance, a few studies suggest that the simultaneous use of pointing gestures and verbal cues helps children develop an understanding of mathematical concepts (for a review, see Goldin-Meadow, 2011). However, to our knowledge, no one has yet investigated whether adults' pointing gestures alone can help children to develop an understanding of spatial cognitive problems.

In the present study, we therefore addressed the following question in two experiments: Would trustful pointing gestures given by an adult help children to [1] succeed and [2] understand spatial problems that have not yet been mastered? To answer this question, we used two invisible displacement problems (translation – Experiment 1; rotation – Experiment 2) known for inducing a strong spatial search bias in children (Barth & Call, 2006; Lasky, Romano, & Wenters, 1980; Okamoto-Barth & Call, 2008; Sophian, 1984, 1986). In these spatial tasks, when the container inside which the object is hidden is invisibly moved from its initial location to a new location, despite the fact that they visually track the displacement of the target container to the new location, 2- to 4-year old children primarily search at the spatial location where they saw the object disappear (Okamoto-Barth & Call, 2008; Sophian, 1984, 1986). To our knowledge, however, no study has yet investigated whether children's prepotent, but erroneous, response in the translation and rotation spatial tasks can be overcome by the use of adults' pointing gestures.

In this study, we therefore used the translation and rotation spatial tasks to investigate whether 2- to 4-year-old children would choose the location where they saw the object disappear or the location pointed by an adult. In both spatial tasks, at the end of the manipulation, an adult either gave (social condition) or did not give (non-social condition) brief informative pointing gestures about the new spatial location of the object. Given that children's social cognition develops at an early age and is predominant when dealing with various social and spatial circumstances (Herrmann, Hernàndez-Lloreda, Call, Hare, & Tomasello, 2010), we hypothesize that children would use adults' pointing gestures instead of their own (but erroneous) spatial knowledge to retrieve the object that has been moved invisibly from one location to another. Moreover, in Experiment 2, we also specifically addressed the question of whether repeated exposures to adults' pointing gestures would help children to learn that an object can move invisibly from one location to another by means of a transport container. If they do so, the children, after being exposed to social cues in the invisible displacement problem, should later succeed at these same spatial problems in the non-social condition, that is, when an adult gives no pointing gestures.