

Response to Silvio Loddo's Commentary

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Recently, there have been many attempts to provide alternate explanations for the pattern of results of children tested using Meltzoff's (1995) procedure. In a recent study of typically developing children, for example, Huang, Heyes, and Charman (2002) claim and provide evidence that instead of understanding the adult's unfulfilled intention in the Intention condition, children could have been using nonsocial information such as their understanding of the objects' affordances or spatial contiguity cues suggested by the adult's behavior.

However, for typically developing infants, at least, there are counterarguments to this claim. For example, if all children are using information about the physical properties of the object, suggested by the actor's behavior, then why did children fail to perform the target action in Meltzoff's (1995) mechanical device condition, in which a machine's "grabbers" performed the same action the human had in the Intention condition? More important, now there is also supporting evidence of understanding of others' intentions from many different types of methodologies for typically developing children. Other studies of typically developing infants show that by 14 months of age, infants copy intentional but not accidental actions (Carpenter, Akhtar, & Tomasello, 1998), use the context to interpret adults' behavior (Gergely, Bekkering, & Király, 2002; Woodward & Sommerville, 2000), expect actors to behave rationally (Gergeley, Nádasdy, Csibra, & Bíró, 1995), and so on. In these studies, alternate explanations along the lines of Loddo's and Huang and colleagues' are not possible because the actor's actions were identical across conditions—the only thing that varied was the actor's intentions or the context (Tomasello & Carpenter, *in press*). These converging lines of evidence strongly suggest that Meltzoff was indeed measuring understanding of others' intentions in typically developing 18-month-old children. Thus, even though at first glance alternate explanations that

do not involve mental state understanding may seem more parsimonious (because they involve lower-level processes or understanding), in fact, the more parsimonious explanation (because it applies to so many different situations) may be that by 14 months of age, typically developing infants, similar to adults, naturally see others' behavior in terms of the intentions behind it instead of simply seeing unrelated surface movements.

Unfortunately, we do not yet have these converging lines of evidence (one way or the other) for children with autism. What few studies have been done using other methodologies have yielded mixed results. Thus, because it is such a theoretically interesting and important question, we need to be cautious about attributing understanding of (any) mental states to very young children with autism. We agree that it is possible that the children with autism in our study could produce very similar results to those of matched control children and typically developing infants, but without the same social-cognitive understanding. However, we think it unlikely that they would do so in the specific way that Loddo suggests; that is, by "match[ing] this initial sequence with a complete sequence they stored in mind, because of previous experiences with the same or similar materials." Each of the eight objects we used was novel to the children, having been constructed specifically for this task (and recall that when children performed the to-be-modeled action in the baseline period—as happened only rarely for children with autism—that action was replaced with a more novel one). Children would need a previous learning history for each object or action to use Loddo's strategy. Our finding of no statistically significant difference between the Intention and End State conditions could in fact be seen as support for Loddo's general argument that children with autism could be using their understanding of objects instead of people in this task. However, note that we found the same pattern of results for the control group of children with other developmental delays as

well, who are not theorized to have any deficits in mental state understanding. A more likely alternate explanation, we think, would be something along the lines of Huang and colleagues' (2002) proposal; that is, that the demonstrator's arm movements might have suggested something that could be done to the object (and that children only pick up these cues from animate actors).

Loddo suggests that a more convincing study would be one in which participants are required to "observe an action a person is performing and at the same time . . . try to guess her intentions through a scanning of her facial expressions or accompanying body gestures." However, there is evidence that even very young children with autism—including the very same children studied by Carpenter, Pennington, and Rogers (2001)—check the face of adults immediately after adults perform ambiguous actions (Carpenter, Pennington, & Rogers, 2002; Charman *et al.*, 1997; although, see also Phillips, Baron-Cohen, & Rutter, 1992). In addition, we and our colleagues have also recently conducted a study in which participants must use others' "facial expressions or accompanying body gestures" to interpret their behavior, and we are finding that this appears to be much easier than similar imitation tasks in typically developing infants and also in some nonhuman animals (Behne, Carpenter, Call, & Tomasello, in preparation; Call, Hare, Carpenter, & Tomasello, submitted). It will be informative to see whether this holds for children with autism as well. We think that it may well do so—and that what we measured in the Carpenter *et al.* (2001) study was indeed an understanding of some level of intentional action—especially given, first, the apparent presence of this understanding in typically developing infants long before any signs of understanding of more complex, less observable mental states such as beliefs and, second, the apparent presence of this understanding in some nonhuman animals (Call *et al.*, submitted; Call & Tomasello, 1998). That having been said, whether children with autism (and young typically developing infants and nonhuman animals) truly have an understanding of others' intentions with all that implies in the philosophical sense, or instead whether they are limited to seeing others' behavior as goal-directed or rational is an open question at this point.

Finally, it is somewhat ironic that Loddo invokes an executive or central integration deficit as an explanation of the abnormal development of social cognition found in people with autism, as we have proposed such a theory (Ozonoff, Pennington, & Rogers, 1991; Rogers & Pennington, 1991). Unfortu-

nately, later tests of this theory (Dawson *et al.*, 2002; Griffith, Pennington, Wehner, & Rogers, 1999) have failed to find executive deficits in young children with autism when compared with young controls with developmental disabilities. These null results seriously question the specificity and, hence, the primacy of executive deficits in the development of the symptoms of autism. Loddo is correct to recognize that the understanding of intentionality is a crucial test of the executive theory of autism (see Russell, 1996), just as it is for the Theory of Mind theory (see Baron-Cohen, 1995).

We hope that we have illustrated the need for further work in this area. Not only must we use different methodologies to test the understanding of others' intentions in children with autism, but it is also theoretically important to determine what level of understanding these children have.

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