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Just How Joint Is Joint Action in Infancy?

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Abstract

Joint action is central to countless aspects of human life. Here I examine the roots of joint action in infancy. First, I provide evidence that—contrary to popular belief—1-year-old infants do have the social-cognitive prerequisites needed to participate in joint action, even in a relatively strict sense: they can read others' goals and intentions, they have some basic understanding of common knowledge, and they have the ability and motivation to help others achieve their goals. Then I review some evidence of infants' and young children's active participation in different types of joint action, from prelinguistic communication to more instrumental collaborations with others, with a particular focus on whether young children show evidence of an understanding of the commitments and obligations entailed in joint action. I conclude that the uniquely human ability and motivation to participate in joint action is already seen in infants by 1 year of age.

Keywords: Joint action; Shared intentionality; Cooperation; Commitment; Goal; Common knowledge; Helping; Communication

1. Introduction

Ask anyone to come up with a list of abilities that are unique to humans and at the top of their list you will find things like language, the use and cultural transmission of artifacts and technology, and social practices and institutions. But there are countless other ''smaller'' things, from going out to lunch with a friend to sharing interest in a butterfly your toddler has pointed out to you to carrying in a new sofa with your spouse, that are also uniquely human activities. We would argue that all of them—the ''big'' ones like language and social

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institutions as well as the ''smaller'' ones like going out to lunch together—have something in common, something that is itself unique to humans: they all involve shared intentionality, the skills and motivation to share goals, intentions, and other psychological states with others (Tomasello, Carpenter, Call, Behne, & Moll, 2005).

Shared intentionality is the foundation upon which joint action is built. In another paper in this special issue Josep Call discusses the phylogenetic roots of joint action and the human uniqueness of shared intentionality (see also Tomasello et al., 2005). Here I examine the ontogenetic roots of joint action in infancy. I begin by laying out what is needed to participate in truly joint action, in the strict sense philosophers use to discuss joint action in adults. I provide evidence that, perhaps surprisingly, by 1 year of age infants have most of the prerequisite skills they need to engage in joint action, even in something like this strict sense. Then I review in more detail a series of recent experimental studies from our lab that investigate infants' and young children's active participation in various types of joint activities. I conclude by answering the question posed in the title of this paper: Just how joint is joint action in infancy?

2. The social-cognitive building blocks of joint action

Infants participate in many different types of social interactions, from face-to-face interactions with their caregivers as babies to more instrumentally collaborative activities as toddlers. From the outside, these interactions certainly look quite rich and social. But can they really be said to be joint action, with all that this term implies?[1] If so, when? To answer this question we need to begin by specifying what we mean by joint action. I will use a more restrictive definition than that used, for example, by Sebanz, Bekkering, and Knoblich (2006), in which joint action is ''any form of social interaction whereby two or more individuals coordinate their actions in space and time to bring about a change in the environment'' (p. 70). We think the shared goal which is missing from this definition is crucial, and it is in part what distinguishes the group activities of other animals from those of humans (Tomasello et al., 2005).

For the purposes of the current paper, I will thus adopt Bratman's (1992) influential formulation of joint action or shared cooperative activity. Bratman argued that in order for an activity to be considered shared or joint each partner needs to intend to perform the joint action together ''in accordance with and because of meshing subplans'' (p. 338) and this needs to be common knowledge between the participants. Bratman also discussed two other important characteristics of shared cooperative activity: commitment to mutual support or help, and commitment to the joint activity (see Gilbert, 1990, for more on the commitments and obligations engendered by joint action). Thus, if we decide to go to lunch together, we first need to coordinate when and where to meet. If you do not know where the restaurant is, I should help you find it. And, once we are at lunch, if you see someone you would rather eat lunch with, you cannot (should not) just get up and leave me—at least not without some sort of apology and excuse. Some of the most basic prerequisites for joint action are thus an understanding of others' goals, intentions, and common knowledge, the ability to help

others, and an understanding of commitments. In addition, one needs the motivation to act jointly with others in the first place.

Tollefsen (2005) has suggested that since infants apparently do engage in joint action, but lack a ''robust theory of mind,'' these kinds of definitions of joint action are too complex. Instead, she proposes that infants can use simpler skills—''intentions-in-action,'' social referencing, and joint attention—to engage in joint action. However, here I will present new evidence that suggests that infants' theory of mind is much more robust than previously thought, and that by their first birthdays infants possess at least most of Bratman's prerequisites for joint action.

2.1. Understanding of others' goals and intentions

There are now quite a few studies that show that 1-year-old (and even younger) infants understand the goals underlying others' actions, and, importantly, that they can actively use this understanding to respond appropriately to others' behavior in social interactions. For example, Behne, Carpenter, Call, and Tomasello (2005) found that 9-month-olds respond more patiently when an adult social partner is unable to give them a toy (due to failed attempts or accidents) than when she is unwilling to give them a toy (see also, e.g., Carpenter, Akhtar, & Tomasello, 1998; and Meltzoff, 1995; for further evidence of goal understanding in 14–18-month-olds). Younger infants—6-month-olds—respond actively in Behne and colleagues' test but do so indiscriminately, without regard for the adult's differing goals. That this is more than just an understanding of intentions-in-action, but rather mental goals, is suggested by studies in which infants respond differently even though the model's actions are *identical* in different conditions, with just the context being different (e.g., Carpenter, Call, & Tomasello, 2005).

By 12 months of age infants may understand something more than others' goals (their desired end state). They also arguably show evidence of understanding something about others' intentions or plans for action—the means others have chosen to use to achieve their goals. The evidence is sketchy since little research has been done on this topic with children this young, but we believe that findings from a study by Gergely, Bekkering, and Király (2002) are informative. In that study, 14-month-olds imitated an unusual action less often when the actor's use of that action could be explained away as a choice forced by her circumstances (see also Schwier, van Maanen, Carpenter, & Tomasello, 2006, for similar results with 12-month-olds). Although there are other possible less mentalistic interpretations of these findings (see Gergely et al., 2002), we think these results suggest that infants see others' behavior as governed by rational choices of action plans that take into account the situation and the constraints on the actor.

By their first birthdays, infants thus appear well equipped to know what a social partner's goal is and to mesh subplans with their partner. But this is not enough to share intentions with others. My subplans can mesh with yours all the way through but unless we intended this to happen, and know this together, it is not a joint action with a shared goal in Bratman's sense. Common knowledge of the joint goal and joint intentions is key, and is, in large part, what distinguishes more inclusive definitions of joint action (e.g., Sebanz et al., 2006) from stricter ones.

2.2. Common knowledge

Common (or mutual) knowledge, at least as discussed by philosophers, is a very complex thing (see, e.g., Clark & Marshall, 1981; Schiffer, 1972). There are two main difficulties for infants: (a) understanding something about others' knowledge in the first place; and (b) being able to deal with the infinitely regressive structure seemingly needed to make it common (I know that you know that I know… *p*). Largely in response to observations of joint action in infancy, there have been several proposals that joint attention can be substituted for common knowledge both in infant and adult joint action (e.g., Sebanz et al., 2006; Tollefsen, 2005). This is a reasonable suggestion, at least for relatively simple joint actions: it would at least allow partners to know that they are focused on the same task, in mutual awareness of this (see Brownell, Ramani, & Zerwas, 2006; for evidence that children's skill at responding to joint attention is related to their ability to coordinate actions with peers in collaborative contexts). But there is now evidence that 12-month-olds have some understanding of others' knowledge/ignorance: for example, they point out the location of a fallen object more often when an adult has not previously seen it fall than when she has (Liszkowski, Carpenter, & Tomasello, 2008; see also Tomasello & Haberl, 2003). More to the point, 1-year-olds understand something basic about common knowledge, in the sense of what is known or has been experienced together. It is unlikely, to say the least, that this is common knowledge in the full sense, with all its iterations, but it is still more than joint attention because it is not tied to the perceptual present. The strongest evidence comes from studies in which 14-month-olds use the common ground or experience they have shared with an adult to interpret the adult's ambiguous communication (Liebal, Behne, Carpenter, & Tomasello, 2009; Moll, Richter, Carpenter, & Tomasello, 2008; Saylor & Ganea, 2007). For example, in the Moll et al. (2008) study, 14-month-olds knew which of three objects an adult was referring to ambiguously based solely on what particular experiences the two of them had shared with each of the objects previously. Various control conditions ruled out lower-level explanations involving simple associations between the adult and the objects, and showed that infants responded not based on what they themselves knew about the objects, nor on what the adult knew individually, but instead on what they knew together. By 14 months, infants thus know what ''we'' know together.

2.3. Summary so far

Despite the common impression that joint action needs to be dumbed down for infants due to their ''lack of a robust theory of mind'' (e.g., Tollefsen, 2005), recent research has shown that, at least in terms of mental-state understanding, all the important social-cognitive building blocks for joint action appear to be in place: 1-year-old infants understand quite a bit about others' goals and intentions and what knowledge they share with others.

But all this understanding will not do infants much good if they do not have the *motivation* to share psychological states and activities with others. As Call (this issue, pp. 368–379; see also Tomasello et al., 2005) points out, chimpanzees and other apes understand

something about others' goals, intentions and knowledge but apparently do not engage in joint action in this strict sense.

2.4. Motivation to share psychological states with others

Tomasello et al. (2005) proposed that a uniquely human motivation to share psychological states with others transforms whatever social-cognitive understanding and skills infants have at any given age into a special, shared version of that understanding and its resulting skills: if infants understand others' emotions, they will be able and motivated to share emotions with others, if they understand goals they can and will share goals, and if they understand attention they will engage in joint attention. The capacity for shared intentionality and joint action is thus a direct result of the interaction between infants' understanding of others' psychological states and their motivation to share those states with others.

The motivation to share psychological states and activities with others is evident from very early in infancy in the delight with which babies participate in face-to-face interactions with their caregivers (e.g., Trevarthen, 1980). The extent of this motivation can be seen particularly clearly somewhat later, in triadic interactions, when infants start actively showing adults objects, and voluntarily tear themselves away from interesting sights to engage in joint attention (e.g., Trevarthen & Hubley, 1978). As we will see below, the sharing of an activity is often more important to children than the activity itself—it is an end in itself rather than just a means of getting something done.

Once infants understand others' goals and intentions, they are thus ready to begin sharing goals and intentions with others in joint action. But how active is infants' role in joint action—are they able to support it by helping their partner? And what do they understand of their own and others' commitments to the joint action? Next I look briefly at studies of helping and commitment in infants and young children.

2.5. Helping

One-year-olds are not just capable of helping others but are also apparently very motivated to do so. They can help in a variety of different ways, for example by pointing for adults to provide needed information (Liszkowski, Carpenter, Striano, & Tomasello, 2006) or more instrumentally by fetching out-of-reach objects or opening cabinet doors for them (Warneken & Tomasello, 2006, 2007). They do this spontaneously, without the adult having asked for help. By 12–14 months, infants are thus well prepared to provide active help or support to others in joint actions.

2.6. Commitments and obligations

There has been little previous work on children's understanding of commitments and obligations. The few studies that have been done have tested older children using verbal story tasks (e.g., Mant & Perner, 1988), which are inappropriate for use with very young children.

2.7. Summary

It is only by the age of about 12 months that we have evidence that infants have at least most of the prerequisite skills and motivations needed to engage in truly joint action, even in a relatively strict sense, with shared goals and mutual support (with regard to commitments and obligations, there is little evidence either way). Next we turn to some recent experimental studies of joint action to see just how rich it really is.

3. Some experimental studies of joint action in infancy and early childhood

3.1. Prelinguistic communication as joint action

Clark (1996) has pointed out that language is a type of joint action. We would argue that prelinguistic communication can be considered joint action as well, at least by 12–14 months of age. The best evidence comes from infants' production and comprehension of the pointing gesture. Around 12 months, infants begin pointing ''declaratively,'' to share attention and interest about objects with a social partner. There are two recent findings that highlight the joint nature of this activity. First, in response to claims that 12-month-olds do not point to share attention and interest but rather for more egocentric reasons, simply to gain rewarding positive emotions to the self (Moore & D'Entremont, 2001), Liszkowski, Carpenter, Henning, Striano, and Tomasello (2004) manipulated an experimenter's reaction to 12-month-olds' declarative points to interesting objects. The adult reacted either by engaging in joint attention with infants about the object, by just responding with positive emotion to infants (ignoring the object), by just looking at the object, or by ignoring the point. Infants' patterns of repeated pointing within trials vs. continued pointing across trials indicated that they were only satisfied when the adult reacted in joint attention. Their point was an invitation to a joint action: to share attention to this object. A second study suggests that 12-month-olds can help their partner achieve this goal, once she has taken it up. If the adult is trying to share attention but misunderstands the referent of the infant's point and ''shares'' to a different object nearby, infants help her by repeating their point (Liszkowski, Carpenter, & Tomasello, 2007).

Infants' understanding of joint action is also reflected in their comprehension of others' pointing gestures. For example, Liebal et al. (2009) had 14-month-olds participate in a ''clean-up'' game with an adult, E1. After throwing a series of objects into a basket together, E1 pointed to another, target object and simply said, ''There!'' Infants picked up that object and threw it into the basket as well, apparently seeing E1's point as related to their joint activity. Infants' responses in a control condition ruled out the possibility that infants were responding egocentrically, based on what they themselves were doing, instead of what they were doing jointly with E1. In this condition infants participated in the cleaning-up activity with E1, exactly as before, but then another adult, E2, pointed at the target object instead. Infants rarely cleaned up the target object in this condition.

Some of the earliest evidence of joint action may thus come from prelinguistic communication (see Tomasello, Carpenter, & Liszkowski, 2007, for a fuller discussion of shared intentionality in infants' comprehension and production of pointing gestures). But, more prototypically, infants around this age are also beginning to engage in more instrumental collaborations involving problem-solving and social games with objects.

3.2. Instrumental collaboration

Warneken, Chen, and Tomasello (2006) presented 18- and 24-month-old children with four tasks in which collaboration was needed in order to achieve some goal. Two of the tasks were problem-solving tasks (involving retrieving an object from an apparatus) and two were social games (e.g., jointly bouncing a block on a small trampoline). In order to test how rich infants' participation in the joint activities was, Warneken et al. had the adult partner suddenly stop playing his role in the middle of the activity, and they coded communicative attempts by children to reengage the adult in the activity. The reasoning was that if children had formed a joint goal with the adult, and understood the commitment this entailed, then they should try to persuade the adult to recommit to the joint goal when he stopped. Warneken et al. also coded how well children coordinated actions with the adult before and after the interruption periods, during the joint activities. They found that children at both ages succeeded in coordinating with the adult in at least some of the tasks, although 24-month-olds did this more skillfully than 18-month-olds. In some cases children were also able to reverse roles in the activity. Importantly, during the interruption periods, all children at both ages actively attempted to reengage the adult communicatively at least once, for example by pointing to the apparatus or pushing it toward the adult.

There are two important things to note here. First, in about half the trials, children's predominate response was either to wait for the adult or to try to reengage him—instead of disengaging from the task or attempting to perform it individually. This is consistent with the idea that since the adult was committed to the shared goal, children had a right to expect that he would continue playing, and thus either waited for him to do so or else communicated with him in some manner (either to request his continued participation or to help him perform his role). Second, Warneken and colleagues also noted two other findings that speak to the motivation children had to cooperate: (a) children participated enthusiastically in the social games, in which there was no material reward; and (b) once they had successfully solved the problem-solving tasks (i.e., retrieved the object from the apparatus), almost all the children replaced the object at some point and repeated the task. The collaborative activity was thus an end in itself, not just a means to retrieving some material reward.

Warneken and Tomasello (2007) subsequently tested 14-month-old infants on two of the same tasks and found that they, too, showed some evidence both of coordination of actions and of reengagement attempts during the interruption periods (see also, e.g., Brownell & Carriger, 1990; Eckerman & Didow, 1989; Hay, 1979; and Ross & Lollis, 1987, for other studies of collaboration in infants).

These studies leave open several questions, however. First, although the findings of Warneken et al. (2006) are consistent with the idea that children were engaging in truly joint

action and understood the mutual commitments this entailed, their understanding of commitments was not directly tested. And second, because all the activities in this study required two players, it is possible that children reengaged the adult simply as a means to achieving an *individual* goal, not a shared goal. That is, children could simply have wanted to achieve the effect (e.g., retrieving the object or seeing the block bounce) and needed the adult as a sort of ''social tool'' to make this happen. In the next series of studies we addressed both of these issues, to determine the extent to which young children really do participate in collaborative activities with shared goals and joint commitments.

Gräfenhain, Behne, Carpenter, and Tomasello (in press) tested slightly older children, 2- and 3-year-olds, on a set of games that could be played either jointly or individually. For example, in one game, each player could use a tool to press one of two levers to make two toy rabbits hop up inside a box (or else a single player could press the levers individually). After the experimenter and an assistant demonstrated the games to children both jointly and individually, children were given the chance to play too, in one of two ways. In the commitment condition, the experimenter invited children to play the game with her (and waited for them to agree to this), then played in a joint manner, attending to children and playing contingently with them. In the no-commitment condition, in contrast, children were told by the assistant that they could play the game; then as soon as they started playing the experimenter approached and played in parallel with them on the same apparatus. After this brief play period, in both conditions there was an interruption period, as in the Warneken et al. (2006) study. We expected that in the commitment condition—but not in the no commitment condition—children's behavior during this interruption period would suggest that they knew they had a right to expect the experimenter's continued participation.

That is exactly what we found with the 3-year-olds. In the commitment condition, most children either waited for the experimenter or attempted to reengage her into the game communicatively, whereas in the no commitment condition children mostly played the game alone. The fact that children waited for or attempted to reengage the adult in the commitment condition, even in these types of games, when they could just have easily played the games alone, suggests that they were not just using the adult as a social tool to achieve their own individual ends—that instead they saw the game as a joint, committed activity.

The 2-year-olds also often waited for or attempted to reengage the adult but, unexpectedly, they did this in *both* conditions. It is unclear what to conclude from these results. If children had no understanding of commitments, they might be expected not to wait for or reengage the adult in *either* condition. The finding that 2-year-olds did wait for or reengage the adult is consistent with the idea that they understood the adult's commitment to the activity; the finding that they did this in both conditions suggests that they may have seen the parallel play in the no commitment condition as a joint activity too. It is possible that young children over-attribute shared goals and joint action: as long as their partner is sitting next to them and playing with the same object they are playing with, they see this as a joint action. On the other hand, it could be that 2-year-olds do not yet understand commitments and responded as they did in the no commitment condition simply because they preferred acting on the apparatus with another person, even if that person was only playing in parallel to them.

The 3-year-olds in the Gräfenhain et al. (in press) study did show the expected difference between conditions. However, because it was not clear on exactly what basis they did so—the commitment (based on the invitation and agreement) or the type of play (contingent vs. not)—Gräfenhain et al. (in press) conducted a second study in which we made the type of play constant across both conditions and only manipulated how the games were initiated. We also looked at a different aspect of commitments and obligations: leave-taking. Instead of measuring children's reactions when the adult partner stopped playing for no apparent reason, in this study we measured how children themselves took leave of a committed joint activity when they were done participating.

In the commitment condition of this study, 3- and 4-year-olds were encouraged to invite the experimenter to play a game with them. Most children did this, and the experimenter accepted their invitation and began to play (basically in parallel to children, but with a verbal reminder halfway through that they were playing together). In the no-commitment condition, the experimenter simply announced that she would like to play and started playing in parallel to children. After 30 s of play, the response period began: across the room, an assistant began playing another, highly attractive game by herself. She gradually attempted to entice children to come play with her, first by simply playing loudly on her own, and eventually by asking if they wanted to play too. The main measure of interest was whether upon leaving the first game for the second one, children spontaneously would acknowledge their leaving to the experimenter, their partner in the first game, for example, by giving her the tool they had used in the game or telling her that they wanted to leave.

We found that both 3- and 4-year-olds acknowledged their leaving to the experimenter significantly more often in the commitment condition than in the no-commitment condition. Since in this study the only difference between conditions was the commitment, as embodied by the initial invitation to play and the acceptance of this invitation (the play itself was identical), this suggests that by 3 years of age children are both sensitive to whether they are in a committed joint activity and also are beginning to know what obligations such committed activities engender. The results of this last study in particular are not easily explainable in terms of children's own individual goals in the activity. Children were not trying to get the adult to do anything; we were measuring how they ended an already successful joint action—whether they made the (technically unnecessary) effort to ''close'' their joint action with their partner or not.

3.3. Summary

By 12–18 months, infants are beginning to participate in a variety of joint actions which show many of the characteristics of adult joint action. They can coordinate actions and support their partners in joint activities, for example, by repairing miscommunications, waiting for the partner, and encouraging her to reengage. Whether children younger than 3 years of age understand joint commitments is unclear, but by 3 years, there is evidence that children are even beginning to feel some of the commitments and obligations inherent in joint action themselves, as when they excuse themselves when they wish to leave a joint action.

4. Open questions and future directions

Clearly, much more work needs to be done before we fully understand joint action in infancy. First, we need more research on infants under the age of 9–12 months. These infants, too, may have some basic understanding of others' goals (e.g., Kamewari, Kato, Kanda, Ishiguro, & Hiraki, 2005; Woodward, 1998) and may be able to engage in some joint attention (Striano & Bertin, 2005). If so, they possess some of the most basic prerequisites for joint action. Very young infants also show mutual responsiveness (e.g., turn-taking and synchronization) in their interactions with adults (e.g., Trevarthen, 1980), and show responses to interruptions in social activity (the so-called ''still-face effect'') that at least on the surface have some commonalities with older children's waiting and reengagement attempts (see Adamson & Frick, 2003, for a review). More work is needed to determine whether these interactions can be characterized as joint action in something like this strict sense too (see, e.g., Legerstee & Markova, 2007; Striano, 2004). We also need to delve deeper into the joint activities of 1- and 2-year-olds to see what kind of understanding of commitment they have. Commitments and obligations are the glue that holds joint action together, and perhaps the best evidence of a shared goal, so this is a very important area for future research.

Second, more work needs to be done on the role of communication in joint action. If commitment is the glue that holds joint action together, communication is the all-purpose tool by means of which joint action is achieved in the first place. One simply cannot be sure one is in a joint action without it. As we have seen here, language is not necessary; nonverbal communication will do—a meaningful look or gesture is all that is needed for everything from the initial invitation and acceptance of the invitation (the establishment of mutual knowledge), to the negotiation of roles and resolution of any coordination problems, to the leave-taking at the end. Communication is thus a critical component of joint action that deserves more research attention.

5. Conclusion

I started this paper with a question about just how joint joint action is in infancy. The answer to this question appears to be: very joint. While I am not claiming that 1- and 2-year-old children have a full, adult-like understanding of joint action—indeed I have presented some counterevidence to that claim here—at least all the basic requirements are in place. One-year-old infants have the capacity and motivation to share goals and mesh subplans with others in common knowledge of this (at some level), and the ability and motivation to support others and help them achieve their joint goals. The jury is still out on whether children younger than 3 years of age understand the commitments and obligations inherent in joint action, but their responses on tasks in which there is an unexpected interruption in the joint activity suggest that they may (Gräfenhain et al., in press; Warneken et al., 2006). The problem is just that these younger children may overdo it when it comes to identifying joint action: it may take some time to know that merely sitting together and

acting on the same object in parallel does not necessarily constitute a joint action with joint commitments.

By 3 years of age it seems clear that children have a more sophisticated understanding of joint action: not only have they differentiated joint and parallel play but they also have begun to comprehend and even feel some of the obligations engendered by joint commitments themselves. By this time, children are also beginning to engage in much more complex—and even imaginary—joint actions, in their joint pretense with others. This sets the stage for some of the ''bigger'' uniquely human joint activities like social institutions and other forms of collective intentionality (Rakoczy, 2007). The roots of the ''smaller'' ones—and in fact many of the smaller ones themselves—are already seen in 1-year-old infants.

Note

1. Note that a similar question applies to the social interactions of other nonverbal creatures, for example, chimpanzees, dolphins, and lions (see the commentaries to Tomasello et al., 2005, and the authors' response).

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