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Goal attributions and instrumental helping at 14 and 24 months of age

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ABSTRACT

Infants reason about goals and helping as early as 3 months of age, but toddlers fail to help others appropriately until well into the second year. Five experiments explored the reasons for this discrepancy. First, we verified that 14-month-old toddlers encode the goal of an actor's reaching action, in a situation in which a social agent selectively reaches for one of two objects. Then, four further experiments presented toddlers with a social agent who manifested her goal in this manner when the two objects were accessible, and then requested help in obtaining her goal object when the two objects were out of reach. In all the experiments, toddlers responded to the actor's request for help by handing her an out-of-reach object, showing that they understood that a prosocial action was called for and were motivated to perform it. When the two objects had moved out of the social agent's sight so that she could not indicate the goal object directly, 24-month-old children used her prior goal-directed action to select the appropriate goal object, but 14-month-old toddlers did not. The 14-month-olds toddlers helped appropriately only when no attribution of enduring goals was necessary, because the social agent could see the out-of-reach object and both looked at and reached toward it while making her request. These findings suggest striking limits to 14-month-old toddlers' understanding of helping.

1. Introduction

Prosociality is an essential human characteristic manifest by young children (Liszkowki, Carpenter & Tomasello, 2008; Warneken & Tomasello, 2007), but the cognitive abilities that support children's earliest prosocial actions are not clear. For adults, acts of helping are both social and object-directed: they are guided by an understanding of the object preferences or instrumental goals of one's social partner. Moreover, acts of helping are guided by an understanding of second-order mental states: in true acts of helping, the helper's goal is to act so as to realize the goal of the agent whom he helps. Here we probe the development of this understanding in the second year, focusing on aspects of helping to which very young infants are sensitive.

At present, two bodies of evidence suggest conflicting accounts of children's developing understanding of helping and of mental states of preference or desire. On one hand, numerous experiments provide evidence that children's understanding of subjective desires emerges between one and two years of age. In a seminal experiment (Repacholi & Gopnik, 1997), 18-month-old toddlers gave an actor, on request, the food for which the actor had expressed a preference by using language and emotional cues, even though her food preference was at odds with the child's own preference. In contrast, 14-month-old toddlers gave the actor the food item that they themselves preferred. In

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subsequent research, even the older toddlers' ability to ignore their own preference and give the appropriate object was found to be fragile (Chiarella, Kristen, Poulin-Dubois & Sodian, 2013; Wright & Poulin-Dubois, 2012). Although somewhat younger children can use expressions of desire or aversion to gain information about objects (Klinnert, Emde, Butterfield, & Campos, 1986), their ability to reason about the desires of others may be hampered by the challenging task of linking expressions of emotion to internal states or to goal-directed actions (Hepach & Westermann, 2013; Skerry & Spelke, 2014; Vaish & Woodward, 2010).

Further evidence that an understanding of desires emerges in the second year comes from studies of children's use of statistical sampling evidence to analyze the desires of other agents and to guide acts of giving to those agents (Ma & Xu, 2011). If an agent pulled six apparently boring objects from a jar containing only objects of that type, 22-month-old children gave her a new type of object if she requested an object after a more interesting object became available. If, however, the agent pulled 6 boring objects from a jar containing mostly interesting objects, children gave the agent the boring object in response to the same request, using the sampling information to infer that the agent's preference diverged from their own. At 16 months, in contrast, toddlers did not reliably distinguish between these conditions. All these findings suggest that the ability to reason about an agent's distinctive preferences develops during the second year.

Research by Warneken and colleagues provides evidence that children begin to act altruistically in accordance with an agent's intentions earlier in the second year. At 14 months, toddlers recognize the intent of an actor straining toward an out-of-reach object and readily hand that object to the actor (Warneken & Tomasello, 2007). In this situation, the actor's goal can be read off the ongoing action and need not be inferred from prior actions. In contrast, 14-month-old toddlers fail to help an actor reliably when his goal must be inferred from a prior sequence of actions. For example, 14-month-old toddlers who have viewed an actor stacking a succession of books fail to help him by placing a book on top of a stack after it falls off, perhaps because a fallen book could elicit multiple actions, and only the actor's prior activity suggests which action is the appropriate one (Warneken & Tomasello, 2007).

In contrast to this literature, a second body of research suggests that a much earlier understanding of desires and preferences guides infants' interpretation of an actor's intentional actions. In groundbreaking experiments (Woodward, 1998; see Woodward, 2009, for review), 6-month-old infants were habituated to a human hand intentionally reaching for and grasping one of two different objects, and then the objects' locations were switched. In new goal test trials, the hand reached to the same location as in habituation but grasped a new object, whereas in new path trials the hand moved to the opposite location and grasped the original object. Infants dishabituated to the new goal trials, providing evidence that they encoded the reaching action as directed to the goal object. When given prior reaching experience, infants show this looking pattern as early as 3 months of age (Sommerville, Woodward, & Needham, 2005), and they use their goal understanding to infer not only which object a person will reach for but how directly she will reach for it (Skerry, Carey, & Spelke, 2013). By 7 months, infants can infer the goal of a reach even when the reach is not completed, and they manifest their goal understanding not only by looking at the actor's reach to the unexpected object but also by selectively reaching for the expected object themselves (Hamlin, Hallinan, & Woodward, 2008). Finally, infants' attribution of goals to one person do not generalize to a second person: a pattern that suggests they appreciate that the preferred goal objects of different people might differ (Buresh & Woodward, 2007).

Further research suggests that infants attribute not only goals but also choices and enduring preferences or desires to the agents who engage in these actions. Luo and Baillargeon (2005) showed 5-month-old infants an agent approaching a specific object repeatedly when either a second object was present in a different location (two-object condition) or only the goal object was present (one-object condition). In subsequent test trials, both objects were present in both conditions, and the agent alternately approached each of them. In the two-object condition, infants looked longer when the agent approached the new object in test trials, whereas infants in the one-object condition looked equally when the agent approached the two objects. Luo and Baillargeon concluded that infants viewed the agent as choosing the goal object when an alternative choice was available, in accord with Ma and Xu's findings with older (but not younger) toddlers. This choice led infants to infer that the agent preferred the goal object to the other object (Luo & Baillargeon, 2005). These findings and others (Luo & Baillargeon, 2007; Luo & Johnson, 2009) suggest that one-year-old infants possess an understanding of intentional action that is linked both to representations of perceptual awareness and to preferences, and that is elicited when infants view agents who choose between two objects. Nevertheless, a wealth of experiments provides evidence that infants also can attribute goals to an actor who reaches for a single object under some conditions (e.g., Skerry et al., 2013; see Gergely & Csibra, 2003, for review), prompting alternative interpretations of Luo's findings that do not attribute to infants any representations of an agent's enduring preferences (Hernik & Southgate, 2012).

Finally, research using passive observation methods similar to those just described provides evidence that young infants have some understanding of helping, for they respond positively to agents whose actions helped other agents to achieve their goals (Hamlin, Wynn, & Bloom, 2010). Infants viewed events in which one agent (the protagonist) first attempted to climb a hill, open a box, or play with a ball, and then two other agents (respectively, the helper and hinderer) acted in a manner that either allowed the protagonist to complete his goal or prevented him from doing so. After these events, the protagonist was removed and infants were given a choice between the helper and hinderer. At 6 months, infants reached more for the agent who previously was helpful (Hamlin, Wynn, & Bloom, 2007). At 3 months, infants

looked more at the helper, relative to the hinderer (Hamlin et al., 2010). Both findings suggest that young infants prefer an agent who helps an actor to achieve his goal. These abilities do not require an understanding of the protagonist's enduring goals or preferences, however, because his goal is apparent at the time of the helper's and hinderer's actions. Moreover, the findings do not reveal whether infants' social evaluations depend on inferences about the mental states of the helper and hinderer or on perceptions of the consequences of their actions.

Further experiments, however, provide striking evidence that 10-month-old infants, like adults, represent acts of helping in a manner that takes account both of the enduring preferences of the protagonist and of the prior perceptions of the helper and hinderer. Infants first viewed events in which the protagonist selectively approached one of two objects (the target) while two other agents watched him. Then two barriers appeared, each blocking the protagonist's access to one of the objects, the protagonist jumped behind and between the barriers, indicating a desire to get to an object without indicating which object he sought. Finally, each of the other agents raised a different barrier, affording access to one of the objects. In a subsequent test, infants showed a preference for the agent whose action allowed the protagonist to attain the target object, suggesting that (a) they represented the protagonist's enduring goal, and (b) they viewed the action of that agent as helpful. Importantly, this preference was not observed in a second condition, in which the non-target object was not present during the protagonist's initial approach to the target: as in Luo and Baillargeon's (2005) experiments, infants attributed an enduring goal or preference to the protagonist only when he had previously made a choice between two objects. Moreover, this preference was not observed in a third condition, in which both objects were present as the protagonist approached one object, but the other two agents were not present to observe the protagonist's choices. Thus, infants showed striking sensitivity to the interplay of perceptions and goal-directed actions in their social evaluations of helpers (Hamlin, Ullman, Tenenbaum, Goodman, & Baker, 2013): Infants preferred an agent whose actions helped another agent to achieve its goal, in the absence of any perceptible indicator of the latter agent's current goal. Moreover, infants showed this preference only when the protagonist's actions involved a choice between two available objects, as in Luo's studies, and only when the helper and hinderer had witnessed the protagonist's choice. Like adults, infants under one year of age appear to incorporate information about agents' mental states when reasoning about helping situations.

Further support for this conclusion comes from experiments focused on infants' understanding of communication and helping (Martin, Onishi, & Vouloumanos, 2012; Vouloumanos, Martin, & Onishi, 2014). Infants saw one person (the agent) selectively reach for one of two objects (the target) repeatedly in familiarization, and then saw a second person (the helper) reach equally for each of the two objects in the agent's absence, demonstrating no preference between them. In test trials, the objects were manually accessible to the helper but not to the agent; the agent looked at the helper and either spoke or coughed, and the helper presented the agent with one or the other object. In most of the experiments, the helper was not present when the agent reached selectively for the target object and thus had no prior knowledge of her preference at the time of her communication. At both 6 and 12 months, infants looked longer when the helper gave the agent the non-target object after hearing the speech (but not the cough), suggesting that the speech act provided this information. In a further condition in which the helper was present during the agent's initial, selective reaching for the target, infants looked longer when the helper gave the non-target object after hearing the cough as well, suggesting that the helper had come to know the agent's preference by witnessing her prior object-directed actions. Thus, infants appear to use both acts of speech and acts of selective reaching to predict the helper's actions.

In the studies of Hamlin et al. (2013) and Martin et al. (2012), infants make the same evaluations and predictions as would an adult who has achieved a mentalistic conception of action, communication and helping. None of the above studies reveals, however, whether infants share this conception. Infants may attribute enduring goals and preferences to the protagonist in a helping situation, and attribute second-order goals (i.e., the goal of acting so as to satisfy or thwart the goal of the protagonist) to the characters who help or hinder him. Alternatively, infants may only expect that the parties to a positive social interaction will tend to adopt the same or converging actions (Powell & Spelke, 2013), and infants may prefer characters who manifest this behavior when they are perceptually accessible to one another (Powell & Spelke, 2014). On the latter interpretation, infants might understand acts of helping as manifesting prosocial behavior, but they might fail to view protagonists as having desires that are distinct from those of their helpers, and they might fail to view the instrumental actions of helpers as guided by second-order social goals.

In addition to the evidence from studies using active helping tasks, three findings from studies using passive observation tasks are consistent with the latter interpretation. First, 14-month-old toddlers use an agent's visual attention but not her emotions to predict her actions in a Woodward task (Vaish & Woodward, 2010), and younger infants both fail to use an agent's visual attention to support such action predictions (Phillips, Wellman, & Spelke, 2002) and show no expectation of congruency between the valence of actions on objects and of emotional reactions to objects in a more sensitive pupil dilation paradigm (Hepach & Westermann, 2013). These findings suggest marked limits to young infants' sensitivity to, and understanding of, agents' desires. Second, 9-month-old infants tested in a Woodward paradigm use information from an agent's prior goal-directed actions on an object to interpret her new actions on the same object when they view the agent in the same room but not when they, and the agent, move to a different room (Sommerville & Crane, 2009), suggesting that attributions of enduring preferences are fragile at best (see also Garvin & Woodward, 2014). Third, infants begin to expect that an agent will react with

positive emotion when her actions successfully attain her goals toward the end of the first year; at 10 months, such infants still fail to expect that an agent will with negative emotion when she fails to achieve her goal (Skerry & Spelke, 2014). All these findings suggest that young infants fail to make the desire or preference attributions that adults make when they observe agents' goal-directed actions.

In summary, research on children's helping, on infants' responses to acts of helping by others, and on infants' inferences about the goals and preferences of other agents yields a complex picture of the early development of understanding of helping. Why do children evaluate acts of helping appropriately as young as three months of age (Hamlin et al., 2010) yet engage only in very limited helping actions at 14 months (Warneken & Tomasello, 2007)? Moreover, why do children appear sensitive to the enduring preferences of goal-directed actors as early as 3 months in some studies (Luo, 2011) but fail to do so as late as 9 or 14 months in other studies (e.g., Sommerville & Crane, 2009; Warneken & Tomasello, 2007)?

The current study attempted to address these questions through experiments whose methods bridge these two sets of studies. We asked whether children can reason about a social agent's goals and preferences for the purposes of prosocial interaction when there is more than one object available for instrumental helping, and when the children must use prior evidence from an agent's goal-directed actions to infer the agent's current perceptions and preferences. In contrast to many studies using active helping paradigms, we tested for these abilities using very simple events, designed to match events used in the simplest studies of infants' attributions of goals and preferences to agents (Luo & Johnson, 2009; Woodward, 1998). We first demonstrated, in Experiment 1, that 14-month-old toddlers encode reaching actions in terms of goal objects in a social context that might also elicit helping: consistent with all the earlier literature, the toddlers were sensitive to the goal of a social agent's reach. Then, across four additional experiments, we provided children with this evidence of a social agent's object preference and then presented them with a situation in which the preferred and the dispreferred object both lay beyond the agent's reach and sight, and the agent requested the child's help in obtaining the desired object. By manipulating both the location and the visibility of the desired object, we ask whether children use information from a social agent's prior goal-directed reaching to guide their own acts of helping. Together, the experiments suggest strong limits to young children's understanding of helping, of agents' enduring preferences, or both.

2. Experiment 1

Experiment 1 was undertaken to investigate whether the simple action sequences that elicit goal attributions and preferences in young infants who are presented with agents in a non-social context (Luo & Johnson, 2009; Woodward, 1998) also elicit goal attributions in toddlers, presented with social agents in a context that might also elicit helping. Experiment 1 presented toddlers with a person who first greeted the toddler and engaged in a brief social interaction and then performed the sequence of object-directed reaching actions to be used in Experiments 2–5. Following the method of Woodward (1998), the person first looked at each of two objects and then reached for and grasped one of the objects for at least 6 trials. After meeting a criterion of habituation or viewing 12 successive trials, the objects switched locations and the person engaged the toddler in a second social interaction, asking the child where the object had moved. Finally, toddlers saw two test events in alternation: new goal trials, in which the person reached for the new object in the same direction as her previous reaches, and new side trials, in which the person reached for the same object as in habituation but on the opposite side. Looking times to these two test events were measured and compared. If toddlers encoded the reaches as directed to the goal object, then they should have looked longer on the new goal trials. In light of the rich body of findings using this paradigm (see Woodward, 2009, for review), we predicted that toddlers would show this pattern.

2.1. Method

2.1.1. Displays

The experiment was conducted with the participant facing an experimenter, who sat behind a table in a small booth. The walls of the booth were covered with black fabric to minimize distraction. On the table sat a tray with a platform measuring 81 cm wide by 18 cm tall by 22 cm deep. Objects were placed 46 cm apart on top of this platform during habituation and test trials. The objects—a small soft orange basketball and a brown plush teddy bear—measured approximately 13 cm in size. A black foam board screen could be raised and lowered between the child and the experimenter, occluding the booth between trials.

2.1.2. Participants

Participants were 18 toddlers (10 girls) aged 13 months, 22 days to 15 months, 10 days (mean age 14;9). Participants were recruited from a database of families in the greater Boston area who have agreed to participate in research; they came from a variety of language and ethnic backgrounds. An additional 4 participants began the experiment but were excluded due to fussiness (3), or failure to attend to at least two pairs of test trials (1).

2.1.3. Design and procedure

The experiment consisted of an initial period of social engagement with the actor, followed by the habituation phase, a second, briefer social engagement, and finally the test phase. In the initial phase, the actor briefly greeted and spoke to the toddler, smiling and making eye contact, and then conversed with the parent for approximately 5 min, during which the experiment was explained, the parent's questions were addressed, and consent was given.

In the habituation phase, as in experiments by Woodward (Buresh & Woodward, 2007; Woodward, 1998), toddlers participated in 6–12 trials in which the actor reached for and grasped the ball or bear, and then paused until the child ceased to attend to the event.

Trials were ended by a 2-s look away, following the first 1-s look at the display after the actor grasped the object (minimum: 2 s, maximum: 60 s). The habituation sequence was ended upon a decline of 50% in the total duration of looking at the event outcomes on three successive trials, relative to the first three trials. This phase ended with one additional habituation trial as a baseline measure of their post-habituation attention.

The second social interaction occurred during a single object switch trial that followed the last habituation trial. During the switch trial, the actor was present and looked at the middle of the tray, then at the child, saying "oh! Where did it go? Did it move? Where is it?" The actor then looked down to break eye contact with the child and paused until the participant-controlled trial ended. Toddlers were then presented with three pairs of test trials: one new goal trial and one new side trial in alternation, with order of trial type counterbalanced between participants.

2.2. Results

There were no effects of sex, side of target object, target object identity or order of test trials. A *t*-test comparing the proportion of looking at new goal trials out of total looking time to chance (.5) was significant ($t(17) = 2.290$, $p = 0.035$). Like the 6-month-old infants (Woodward, 1998) and the 3-month-old infants (Sommerville et al., 2005) in previous research, the toddlers encoded the goal of the actor's reach and dishabituated to a change in goal object, relative to a change in reaching direction.

2.3. Discussion

The toddlers in Experiment 1 looked significantly longer at the new goal test events than the new side test events, demonstrating that the events of Experiment 1 do elicit the goal attributions found by Woodward (1998) and others, despite the use of older toddlers and the presentation of these actions within a social context. In Experiments 2–4, therefore, we presented toddlers with the same events, followed by a switch trial that was the same as in Experiment 1 except in one respect: the objects were presented out of the agent's sight and reach. Finally, the objects were brought within the toddler's reach, and the agent requested the toddler's help in obtaining her desired object. Across a series of test trials, we measured whether toddlers would use the goal information from the agent's prior reaching to determine which object to give her.

3. Experiment 2

3.1. Materials

The experiment was conducted with the same physical setup as Experiment 1. The tray and platform had wheels so that the tray could move toward the participant, from a position beyond to a position within the child's reach. Objects were placed 46 cm apart on top of this platform during familiarization trials and on the side closer to the participant for the test trials. The objects used included those from Experiment 1 and additionally a blue plastic bowl, a blue plastic cup, a metal spoon, a yellow rubber ducky, and an orange toy dump truck.

3.2. Participants

Eighteen toddlers (10 girls) between the ages of 13;18 and 15;12 (mean age 14;16) participated in the experiment. Participants came from a variety of ethnic backgrounds, but English was their primary language. An additional 9 participants began the study but were excluded due to fussiness (2), unwillingness to respond (6), or parental interference (1).

3.3. Design

The experiment was conducted in three phases: warm-up, no-choice test phase and choice test. In the warm-up and no-choice phases, single objects were presented to toddlers in a fixed order. In the test phase, target objects, target-object/side pairings, and side of first target object were counterbalanced between subjects. Side of target object at test was counterbalanced within subjects between rounds, with a child receiving one test round with the target object on the left and the next with the (new) target object on the right. All children saw the bear and ball in the first test round. Eight children (2 girls) saw the cup and the spoon in the second test round, and 10 children saw the duck and truck (8 girls).

3.4. Procedure

Two experimenters conducted the study. The first author was always the actor (E1), and one of several research assistants played the role of the other experimenter (E2). The entire procedure took between 10 and 20 min.

3.4.1. Warm-up phase

After playing in the waiting room with the two experimenters, the child and parent were escorted into the testing room and seated in a chair in front of the booth. E2 then familiarized the child to the rolling tray and its movement, showed the child the test objects, and elicited giving in the following manner. E2 produced a single object from beneath the table and looked at it briefly, saying e.g. "oh neat, a bowl." She then offered it to the child, saying "do you want to see it?" If the child did not readily take the object from E2, E2 passed the object to the parent and invited the parent to show it to the child. E2 remained engaged, talking to the child while he or she explored the object. Once the child began to lose interest in the object, E2 asked for the object back, extending a hand palm up toward the child and saying "can I have it back?" If the child did not give the object back immediately, she was given a few more seconds to play with it and then E2 again requested the object. If the child refused to give back the object, E2 asked the parent to hand her the object. This procedure was repeated for the other test objects.

3.4.2. No-choice test phase

The no-choice test round served to familiarize participants with the experimental procedure, to refamiliarize them with E1, and to provide positive feedback for giving of objects. Following the warm-up phase, the screen was lowered in front of the booth and E1 took E2's place behind the table. Using a single object, the bowl, three familiarization trials occurred, in which the screen was raised to reveal E1, who greeted the child, then looked at and reached for the bowl. As she reached for and then grasped the bowl she said "oh, hmm" in a neutral tone of voice with neutral facial expression, pausing in this position for 10 s. Between familiarization and test the bowl was then placed at the end of the tray close to the child and out E1's sight and reach. In the two no-choice test trials that followed, E1 looked at the empty platform with a puzzled expression and said "oh, where did it go?" The tray then moved toward the child, moving the bowl into the child's reaching space, and E1 extended her hand toward the child, palm up, saying "can you help me?" If the child handed the actor the bowl she clapped and thanked the child. If the child did not give the bowl to the actor the trial simply ended with the actor saying cheerfully, "let's do that one more time" (before another no-choice test trial) or "let's try something new now" (before the next test phase).

3.4.3. Choice Test phase

Toddlers first saw three familiarization trials, in which E1 looked at each of the two objects, reached for one of them, and her hand rested on that object while she looked at it for 10 s before the screen was lowered to end the trial (Fig. 1a). Except for the timing, these events were the same as the habituation events in Experiment 1. Following these familiarization trials, the objects' locations were switched and the objects moved to the child's side of the platform out of E1's sight and closer to the child (but still out of the child's reach). Toddlers then saw a single switch scene to familiarize them to the new locations of the objects. For approximately half of the participants E1 was not present and did not speak during the switch scene, which lasted 10 s. For the remaining participants, E1 was present and spoke to the child at the start of the scene, as in Experiment 1, and then looked down for 10 s to give the child time to notice the new locations of the objects.[2]

Two test trials followed, as in the no-choice phase, with the objects moving on the rolling tray toward the child and E1 asking for help (Fig. 1b). If the toddler gave any object she was applauded and thanked. If the toddler was holding either or both objects at the end of the trial, the actor asked the parent to put the object(s) back onto the tray. Once both objects were back on the tray the screen was lowered and the objects reset in their starting positions for the next trial.

Following these two test trials the second test round was conducted following the same procedure, with a different pair of objects. On the four choice test trials, the first object given was coded. See Figure 2 for an overview of the experimental design and procedure.

[2] The children in these two switch scene conditions did not differ in their rates of giving or in their selective giving of the target object, so all analyses collapsed across these conditions.

(a)

(b)

Fig. 1. The end states of the familiarization/habituation trials (1a) and of the test trials for the choice test phase (1b) of Experiments 2–4.

3.5. Results

Toddlers gave an object on average in 72.2% of the no-choice trials and 72.2% of the choice trials. Across the four choice test trials, on average, they gave the target and non-target objects on 1.28 and 1.61 trials, respectively, a non-significant difference that is opposite in direction to that predicted by effective helping (mean difference score: −0.333, $t(17) = -1.065$, $p = 0.302$, two tailed). An independent-samples t-test comparing giving of the target vs. non-target object for male and female participants revealed no significant effect of sex on performance.

A further analysis focused on toddlers' performance on the first choice trial on which any object was given, prior to receiving any (uniformly positive) feedback from the experimenter. Six participants gave the target object on this trial whereas 12 participants gave the non-target object: a non-significant preference for giving the incorrect object ($p = 0.238$, two-tailed binomial test).

3.6. Discussion

In Experiment 2, 14-month-old toddlers saw goal-directed reaching evidence of an social agent's object preference and then were asked to help the agent by giving her an object. On single object trials, the toddlers exhibited

Experiments 2 & 3				
Round	Objects	Events	Experimenter's actions	Counterbalancing/notes
No-choice test round	Bowl	3x fam	Experimenter reaches for and grasps target object	Not applicable
		2x test	Experimenter asks for help, hand extended toward participant	Not applicable
Choice test round 1	Bear & ball	3x fam	Experimenter reaches for and grasps target object	Counterbalanced between subjects: identity of target object, side of target object and object/side pairing
		1x switch scene	Experimenter present and speaking OR absent and silent	For all subjects, objects switch locations between fam and test
		2x test	Experimenter asks for help (hand extended toward participant)	Counterbalanced within subject (between rounds 1 and 2): side of target object at fam, side of target object at test
Choice test round 2	Duck & truck or cup & spoon	3x fam	Experimenter reaches for and grasps target object	Counterbalanced between subjects: identity of target object, side of target object and object/side pairing
		1x switch scene	Experimenter present and speaking OR absent and silent	For all subjects, objects switch locations between fam and test
		2x test	Experimenter asks for help (hand extended toward participant)	Counterbalanced within subject (between rounds 1 and 2): side of target object at fam, side of target object at test

Fig. 2. The procedure for Experiments 2 and 3.

high rates of giving, replicating and extending the findings of Warneken and Tomasello (2007) and suggesting that toddlers understood the request for help and were motivated to comply with it. On choice trials, the toddlers continued to show high rates of giving, but they failed to give the target object significantly more often than the non-target object. Thus, the 14-month-old toddlers seemed to understand the verbal request for help and its accompanying gesture as a request for an object, and they were both motivated and able to provide one. Nevertheless, they failed to use information for the social agent's object preference to guide their choice of which object to give.

Why did toddlers fail to give the person the object that she sought in this experiment? The findings of Experiment 1 suggest that toddler perceived her goal during the reaching events. Perhaps, however, her actions were unnatural in some way during the giving test. Because she interacted minimally with the child during the reaching events, for example, toddlers may have been puzzled by her request for help. Contrary to this possibility, the toddlers' acts of giving objects suggest that they interpreted her request for help appropriately and responded with prosocial behavior, providing her with an object. The young toddlers may have failed to infer the object that she desired, however, as they have done in other studies using active helping paradigms in which direct information concerning the current desire is absent (Ma & Xu, 2011; Repacholi & Gopnik, 1997; Warneken & Tomasello, 2007). Experiment 3 tested this possibility by repeating the method of Experiment 2 with children aged 24 months.

4. Experiment 3

4.1. Method

Participants were 18 children (10 girls) between the ages of 1;11;10 and 2;0;29 (mean age 2;0;2). Participants came from a variety of ethnic backgrounds, with English as their primary language. Seven additional participants were excluded due to fussiness (3) or unwillingness to give any objects during the test trials (4). The displays, design, procedure, and measures were the same as Experiment 2. Eight children (4 girls) saw the cup and the spoon in the second test round, and 10 children (6 girls) saw the duck and the truck.

4.2. Results

Children gave an object on average in 97.2% of the no-choice trials and 95.8% of the choice trials. Rates of

giving in the no-choice trials and the choice test trials were significantly greater for the 24-month-old children in Experiment 3 than for their 14-month-old counterparts in Experiment 2 (no-choice trials: $t(34) = -2.39$, $p = 0.023$: choice trials: $t(34) = 3.002$, $p = .005$, two-tailed).

Across the four choice trials, children gave the target object more often than the non-target object (respectively, on 2.78 and 1.56 trials), a significant difference (mean difference score: 1.222; $t(17) = 2.15$, $p = .028$, two-tailed). An independent-samples t-test comparing giving of the target vs. non-target object for male and female participants revealed no significant effect of sex on performance.

On the first choice test trial on which children gave an object, 10 children gave the target object, 7 children gave the other object, and one child gave both objects simultaneously: a non-significant difference ($p = 0.315$, one-tailed binomial test).

A 2 (Age: 14 vs. 24 months) by 2 (Object: target vs. non-target) repeated-measures ANOVA compared rates of giving the target and non-target objects across the four choice trials of Experiments 2 and 3. There was an interaction between Age and Object given, with the older children in Experiment 3 giving the target object over the non-target object significantly more often than did the younger toddlers in Experiment 2 ($F(1, 34) = 6.79$, $p = 0.014$). A Wald Chi-square test confirmed this finding, showing a difference between Experiments 2 and 3 in children's rates of giving of the target vs. non-target objects (Wald $\chi^2(1) = 4.637$, $p = .031$). In an analysis of performance on the first choice trial on which children gave an object, however, the interaction between Age and Object type did not attain significance (Fisher's exact test: $p = .12$).

4.3. Discussion

The 24-month-old children in Experiment 3 succeeded at helping the social agent in accordance with her object preference, giving her the target object significantly more often than the other object. Children's success in this paradigm at 24 months suggests that the younger toddlers in Experiment 2 did not fail because the helping situations were opaque or unnatural. A comparison of Experiment 2 to Experiment 3 instead suggests that between 14 and 24 months of age, children's helping begins to be guided by information concerning a social agent's goals and preferences.

Though children at both ages evidenced relatively high rates of giving overall, the 2-year-old children gave at significantly higher rates than did the 14-month-old toddlers. This finding accords with the evidence that prosocial behavior increases during the second year of age (Warneken & Tomasello, 2006, 2007).

One aspect of the present findings suggests that children's use of preference information is still fragile at the end of the second year: Children did not reliably use preference information to guide their very first choice of which object to give the social agent when she first requested their help. Because the feedback that children received was independent of the object that they gave, children's success on subsequent trials provides evidence that they indeed inferred the social agent's goal from her past actions, and that they used this inference to guide their own acts of helping. Nevertheless, this process was not firm or robust enough to elicit appropriate helping on the first trial.

Together, Experiments 2 and 3 provide evidence for a developmental change, between 14 and 24 months, in children's use of preference information to guide their helping. This evidence accords with the findings of past studies using active helping paradigms (Ma & Xu, 2011; Repacholi & Gopnik, 1997; Warneken & Tomasello, 2007). Nevertheless, questions remain concerning both the course of this developmental change and its underlying meaning. It is possible that the toddlers in Experiment 2 failed to give the target object more often than the foil object because they failed to encode or remember the social agent's preference. Because Experiments 2 and 3 presented just three familiarization trials and each of the two test rounds used a different set of objects, the younger toddlers' memory may have been overtaxed by these events. In contrast, both the infants in past experiments and the toddlers in Experiment 1 were presented with the same object-directed actions on 6–12 trials in a habituation paradigm. Experiment 4 tested this explanation by presenting 14-month-old toddlers with the same helping test after full habituation to the reaching actions.

5. Experiment 4

Experiment 4 assessed the helping behavior of 14-month-old toddlers after presenting the same sequence of reaching events presented to toddlers in Experiment 1: events that elicited goal attributions that endured for the duration of the subsequent switch trial and the six test trials that followed. Instead of the six looking time test trials from Experiment 1, however, the toddlers then were given four test trials using the giving method from Experiments 2 and 3.

5.1. Method

Test objects in Experiment 4 consisted of the blue plastic bowl, plush brown teddy bear and soft basketball used in Experiments 1–3.

Participants were 18 toddlers (11 girls) between the ages of 13;24 and 15;13 (mean age 14;19). Children came from a variety of ethnic backgrounds, with English as the primary language. An additional 12 participants began the experiment but were excluded due to fussiness (2), unwillingness to respond (9) or parental interference (1).

After warm-up and no-choice tests identical to those of Experiment 2, toddlers were given 6–12 participant-controlled habituation trials in which E1 reached for and grasped the ball or bear and then rested her hand on the object until the child looked away from the event for 2 s, as in Experiment 1. Following habituation to this action, calculated as in Experiment 1, toddlers viewed a single object switch trial which the actor was not present. The actor returned to the scene after the switch trial, and the participant was then given the first

set of two choice test trials, following the procedure of choice test round 1 in Experiments 2 and 3.

After this choice test round, toddlers were given one participant-controlled re-familiarization trial in which E1 reached for the target object in its original location. Then toddlers saw a single trial in which E1 was not present and the objects, though not switching sides after this re-familiarization, had moved forward on the tray closer to the child (though the objects remained out of the child's reach). Then participants received the two trials of choice test round 2, following the same procedure as Exp. 2 and 3. During both of the choice test rounds, therefore, the target objects, target-object/side pairings, and side of target object in first test trial were counterbalanced. Thus, the same pair of objects was used for both choice test rounds, and the side of the target object at test was switched for each child between rounds, with a child receiving one test round with the target object on the left and the next with the target object on the right (see Fig. 3).

5.2. Results

Toddlers gave an object on average in 84.4% of the no-choice trials and 81.9% of the choice trials. These rates of giving did not differ significantly from those of Experiment 2 (no-choice: $t(32) = -0.897$, $p = 0.379$; choice: $t(34) = -1.084$, $p = 0.286$, two-tailed).

Toddlers' rates of giving of the target and non-target objects were statistically indistinguishable (respectively, 1.83 and 1.28 trials on average, mean difference score: 0.556, $t(17) = 1.033$, $p = .316$, two-tailed). Ten toddlers gave the target object on the first choice test trial on which they gave an object, whereas 8 toddlers gave the non-target object on that trial ($p = 0.407$, one-tailed binomial test). An independent-samples t-test comparing giving of the target vs. non-target object for male and female participants revealed no significant effect of sex on performance.

A 2 (Experiment: 2 vs. 4) by 2 (Object: target vs. non-target) repeated-measures ANOVA on performance over the four choice test trials compared the performance of the toddlers in Experiments 2 and 4. There was no significant interaction between Experiment and Object given, with toddlers in both experiments giving the target and non-target objects at similar rates ($F(1, 34) = 2.04$, $p = .162$). A Wald Chi-square test confirmed this finding, showing no between experiments 2 and 4 in rate of giving the target vs. non-target object (Wald $\chi^2(1) = 2.366$, $p = .124$). On the first trial for which toddlers gave an object, the toddlers in the two experiments were equally likely to give each object (Fisher's exact test: $p = .315$).

Experiment 4				
Round	Objects	Events	Experimenter's actions	Counterbalancing/notes
No-choice test round	Bowl	3x fam	Experimenter reaches for and grasps target object	Not applicable
		2x test	Experimenter asks for help, hand extended toward participant	Not applicable
Choice test round 1	Bear & ball	6-12 hab	Experimenter reaches for and grasps target object	Counterbalanced between subjects: identity of target object, side of target object and target object/side pairing
		1x switch scene	Experimenter absent and silent	For all subjects, objects switch locations between hab and test
		2x test	Experimenter asks for help (hand extended toward participant)	Counterbalanced within subject (between rounds 1 and 2): side of target object at test
Choice test round 2	Bear & ball	1x hab	Experimenter reaches for and grasps target object	Counterbalanced between subjects: identity of target object, side of target object and target object/side pairing
		1x switch scene	Experimenter absent and silent	For all subjects, objects *do not* switch locations between hab and test of round 2.
		2x test	Experimenter asks for help (hand extended toward participant)	Counterbalanced within subject (between rounds 1 and 2): side of target object at test

Fig. 3. The procedure for Experiment 4.

5.3. Discussion

The 14-month-old toddlers in Experiment 4 failed to give the actor the target object more often than the non-target object. This failure occurred despite increased exposure to the actor's goal-directed actions in Experiment 4. Because the present paradigm followed the procedure of Experiment 1 closely, and presented events that were encoded as goal-directed by the 14-month-old toddlers in that experiment, it is unlikely that the toddlers in Experiment 4 failed to help the actor because they failed to attend to or remember her actions. Instead, the events of Experiment 4 likely induced the same goal attributions as in Experiment 1, and yet failed to guide toddlers' acts of giving objects during the choice test trials. Together with Experiment 1, Experiment 4 therefore provides the most direct evidence for a discrepancy between 14-month-old toddlers' understanding of goals and their ability to use goal information to guide their helping.

Why did the 14-month-old toddlers in Experiments 2 and 4 fail to help the actor appropriately by handing her the target object? First, toddlers' tendency to give the actor the object she desired may have been counteracted by a preference for giving the other object, because children wanted to see something new happen, and the actor had never manipulated the non-target object. Second, toddlers may have been motivated to help appropriately yet believed that the actor was mistaken to want the target object and would be equally or more pleased by the other object. On either of these two accounts, young toddlers fail to help as older children do because of their differing motivations: older children are more consistently motivated to give the social agent her preferred object. Third, toddlers may have wished to give the actor the object that she desired, but they may have been unable to determine, from her past behavior, which object that was. Despite the findings from studies of infants (Luo & Baillargeon, 2007; Luo & Johnson, 2009), toddlers may attribute goals, but not enduring object preferences, to actors who repeatedly reach for the same object. Fourth, toddlers may lack some aspect of understanding of helping. On either of the last two accounts, young toddlers fail to help as older children do because of limits to their social cognitive abilities: in particular, limits to their understanding of preferences and desires, of the second-order mental states that guide acts of helping, or both.

In addition to these four accounts of toddlers' failure to give the correct object in Experiments 2 and 4, a fifth account can be offered. In the looking time experiments showing precocious performance in infants, children view events without the need to act upon them in the moment. Under these circumstances, they may retrieve information concerning an actor's past perceptions and actions and use that information to interpret the actor's current observed actions. In active helping experiments, in contrast, toddlers must use incoming information to guide their immediate actions. In all the studies in which 14-month-old toddlers help successfully, their helping actions are supported by the ongoing behavior of the social agent whom they help. In Warneken and Tomasello's (2006, 2007) experiments, in particular, 14-month-old toddlers hand the agent the very object to which he is currently looking and reaching. It is possible that toddlers, like infants, can use past information to bear on their interpretation of an actor's present actions. In order to act themselves so as to help the actor, however, they may need to integrate that information with concurrent behavioral support by the social agent whom they help.

Experiment 5 aimed to distinguish between these accounts and consisted of two conditions: congruent and incongruent. In both conditions, a social agent asked for the toddler's help in retrieving one of two out-of-reach objects while looking at and reaching directly toward the desired object. In the congruent condition, this helping test was preceded by familiarization events in which the two objects stood within the agent's reach, and she reached for and attained the same object for which she would reach at test. Performance in this condition should serve to distinguish the two motivational accounts from the three cognitive explanations for young children's helping failures in Experiments 2 and 4, because Experiment 5 reduced the representational demands of the paradigm presented in the previous experiments while maintaining the same motivational structure. Because toddlers received reaching evidence of the agent's current preference and focus of attention during the choice test, they did not need to rely on a preference attribution based on the agent's prior actions together with her current request in order to choose the effective helping action: They only needed to attend to the actor's current focus of attention or reaching gesture. Moreover, the toddlers did not need to formulate a second-order mental state representation in order to perform the appropriate helping action: they only needed to match their own action to that of the social agent and reach for the same object. If 14-month-old toddlers failed to give the target object in Experiments 2 and 4 because they preferred to see the actor handle a new object, or because they thought the actor might be happier with the new object, then the same pattern of performance should be observed in this condition of Experiment 5: Toddlers ought to give the test target object no more often than the test foil. In contrast, if their failure stemmed from limits to their understanding of enduring desires, to their understanding of the second-order mental states that guide acts of helping, or to their ability to recruit this understanding in the moment to perform an act of helping under time constraints, then they should successfully give the social agent her goal object in this condition.

The incongruent condition aimed to distinguish the last account of toddlers' helping failures from the other cognitive accounts. It presented the same helping test as the congruent condition, preceded by familiarization events in which the social agent reached for and attained the object that was not her target at test. If 14-month-old toddlers require present support from an agent's current actions to guide their actions, but they are nevertheless sensitive to information from the agent's past goal-directed actions, and if they and use those past actions to guide their interpretations of the agent's present actions, then the toddlers should respond to the agent's request for help by giving her the requested object more consistently in the congruent condition than in the

incongruent condition. In contrast, if toddlers' acts of helping an agent are not influenced by the agent's prior goals, then the toddlers in both conditions should be equally likely to give the actor the object to which she currently looks and reaches. Such a finding would add weight to the other two cognitive accounts and suggest that young toddlers' helping failures stem from limits to their understanding of agents' desires, of helping, or both.

6. Experiment 5

In Experiment 5, we presented 14-month-old toddlers with the same familiarization trials as in Experiments 2 and 3, followed by test trials in which the two objects were out of reach but remained visible to the actor, who attempted to attain an object (hereafter, the target) by reaching in its direction. Experiment 5 consisted of two conditions: a congruent reaching condition, in which the actor also reached for the target object during familiarization, and an incongruent reaching condition, in which the actor reached for the non-target object during familiarization. By comparing rates of giving the target object across these two conditions, we asked whether toddlers who are presented with supportive concurrent information about an actor's goals and desires also are influenced by an actor's prior goal-directed actions in interpreting the actor's request for help or selecting the helpful action. Furthermore, by comparing toddlers' helping responses in the congruent condition of Experiment 5 to the helping of toddlers in Experiments 2 and 4, we address motivational accounts of toddlers' failures to choose helpful actions in those experiments, by asking whether toddlers are motivated to help by giving the actor's desired object when the actor's current goal is present and obvious.

Experiment 5 importantly differed from all the previous studies in that during all the helping trials, the two objects were visible to the actor, although they were now out of her reach. Moreover, the actor looked and reached toward an out-of-reach target object while requesting help from the child.

6.1. Method

Experiment 5 was conducted using the same setup as Experiment 2, except that the rolling tray with platform was replaced with a similar rolling tray with a lower platform (2.5 cm high), over which E1 could both see and reach toward the target object in test trials, but over which she could not complete her reach from her seated position. As in Experiment 4, the bowl, ball and bear served as objects.

Participants were 36 toddlers (10 girls) aged 13;15 to 15;15 (mean age 14;14) split across the two conditions. Children came from a variety of ethnic backgrounds, with English as the primary language. An additional 19 participants began the experiment but were excluded due to fussiness (3), failure to give an object on any test trial (13), parental interference (1) or experimenter error (2).

As in Experiment 4, toddlers participated in one no-choice test round and two choice test rounds. As in Experiment 2, they saw 3 familiarization trials prior to each test round. The test trials in Experiment 5 differed importantly from those in Experiments 2 and 4 in the visibility of the goal object(s) and in the behavior of E1 on the test trials.

On the two no-choice test trials, the bowl was centered at the end of the tray close to the child. When the screen was raised, the tray moved toward the child into his or her reaching space. Simultaneously, E1 extended her hand toward the bowl making a grasping motion but failing to reach the bowl and saying "oh, I can't reach." She continued reaching for the bowl and made eye contact with the child saying "can you help me?" The no-choice test trials ended exactly as did those in Experiments 2–4.

For choice test round 1, toddlers were familiarized with three trials in which E1 reached for the familiarization target object, as in Experiment 2 (Fig. 4a), and then they saw a single trial (10 s) in which the objects were moved to the end of the tray close to the child (yet still out of the child's reach), while E1 was not visible. In the congruent condition, the objects always switched positions prior to the first test round and then moved back to their original positions for the second test round. Thus, if a child saw the goal object on the left during familiarization that object would appear on the right during the first two trials, then again on the left side for the re-familiarization trial, and on the left for test trials 3 and 4. In the incongruent condition, the timing of this switch (during test round one or two) was counterbalanced between subjects.[3] There followed two test trials, in which E1 reached for but failed to attain one of the test objects (hereafter, the current goal object) as the tray moved away from her and toward the child (Fig. 4b and 4c). She continued to reach for the current goal object, making a grasping motion with her hand and alternating gaze between the child and the object, saying "oh, I can't reach. Can you help me?"

In choice test round 2, toddlers were given one more familiarization trial in which E1 reached for and obtained the original object that she had obtained on the earlier familiarization trials. Then toddlers saw a single trial in which E1 was not present and the objects had again moved forward on the tray closer to the child. Two more choice test trials followed, presenting incomplete reaches for the current goal object (i.e., the original object in the congruent condition and the other object in the incongruent condition. Figure 5 presents an overview of the experimental design and the procedure for Experiment 5.

6.2. Results

6.2.1. Congruent vs. incongruent conditions

On the no-choice trials, toddlers gave the object on 75% of trials in the congruent condition and 55.6% of trials in the incongruent condition. This difference was not significant ($t(34) = 1.38$, $p = 0.176$) and no such difference would be expected, as the no-choice test was identical in the two conditions. On the choice trials, toddlers gave an object on 76.4% of trials in the congruent condition, and 70.8% of

[3] The children in these two object switching conditions did not differ in their rates of giving or in their selective giving of the target object, so all analyses collapsed across these conditions.

(a)

(b)

(c)

Fig. 4. The end states of the familiarization trials (4a) and the test trials for the choice test phase of Experiment 5, congruent (4b) and incongruent (4c) reaching conditions.

trials in the incongruent condition. These rates of giving also did not differ from one another, $t(34) = 0.56$, $p = 0.576$.

A 2×2 ANOVA performed on the choice trials only, with Condition (congruent vs. incongruent) as between-subjects factor and Object given (current goal object vs. other object) as the repeated measure, revealed a main effect of Object given ($F(1, 34) = 10.02$, $p = 0.003$), but no main effect of Condition ($F(1, 34) = 0.47$, $p = 0.498$) and no interaction of Condition and Object given ($F(1, 34) = 0.66$, $p = 0.424$). A Wald Chi-square test confirmed this finding, showing no difference between the congruent and incongruent conditions in rate of giving the target vs. non-target object (Wald $\chi^2(1) = .565$, $p = .451$). Toddlers exhibited higher giving of the object for which the actor was currently reaching across both conditions, and they showed this selective giving equally in the congruent and incongruent conditions.

Across conditions, 24 toddlers gave the current goal object on their first active trial (congruent: 13; incongruent: 11) and 12 toddlers gave the other object (congruent: 5; incongruent: 7) ($p = 0.065$, two-tailed binomial test). An independent-samples t-test comparing giving of the current goal vs. other object for male and female participants revealed no significant effect of sex on performance either within or across conditions.

6.2.2. Experiment 5 congruent condition vs. Experiments 2 and 4

Toddlers' rates of giving an object during no-choice and choice test trials in the congruent condition of Experiment 5 did not differ from those in Experiment 2 (no-choice: $t(34) = 1.061$, $p = .297$; choice: $t(34) = .146$, $p = .885$) or Experiment 4 (no-choice: $t(34) = 1.89$, $p = 0.068$; choice: $t(34) = 1.372$ $p = 0.179$, two-tailed). Thus, toddlers showed equal motivation to give an object across these experiments.

Nevertheless, a 2 (Experiment: 2 vs. 5—congruent) by 2 (object: correct vs. incorrect) repeated-measures ANOVA on the choice test performance revealed a significant interaction of Experiment and Object given, with the toddlers in the congruent condition of Experiment 5 giving the correct object (which was both the original and the current goal object) at higher rates than those in Experiment 2 (for whom the correct object was the goal of the actor's ongoing reach only during the familiarization trials: $F(1, 34) = 9.842$, $p = .004$). A Wald Chi-square test confirmed this finding, showing a difference between experiments 2 and 5 in rate of giving the correct object (Wald $\chi^2(1) = 8.009$, $p = .005$). On the first trial for which a child gave an object, the children in the congruent condition of Experiment 5 also were significantly more likely than those in Experiment 2 to give the correct object (Fisher's exact test: $p = .047$). Both these analyses provide evidence that toddlers' choice of objects was influenced by the current, ongoing behavior of the actor who requested the objects (see Fig. 6).

6.3. Discussion

The toddlers in the congruent condition of Experiment 5, unlike their same-aged counterparts in Experiments 2 and 4, tended to give the actor the object that was the goal of her reach. What produced this difference? The congruent condition of Experiment 5 differed from Experiments 2 and 4 primarily in the nature of the choice test trials. In Experiment 5, the social agent reached, albeit unsuccessfully, toward the target object during choice test trials, allowing toddlers to infer the actor's goal from her current, ongoing action. The actor also could see both objects, and she looked in alternation at the desired object and at the child, allowing the child to draw on capacities for shared attention to focus on the correct object. In Experiments 2 and 4, in contrast, toddlers had to use the actor's previous

Experiment 5				
Round	Objects	Events	Experimenter's actions	Counterbalancing/notes
No-choice test round	Bowl	3x fam	Experimenter reaches for and grasps original object	Not applicable
		2x test	Experimenter asks for help (hand extended toward object)	Not applicable
Choice test round 1	Bear & ball	3x fam	Experimenter reaches for and grasps original object	Counterbalanced between subjects: identity of original goal object, side of original goal object and goal object/side pairing
		1x switch scene	Experimenter absent and silent	Congruent condition: for all subjects, objects switch locations between fam and test. Incongruent condition: timing of object location change between fam and test (round 1 or round 2) counterbalanced between subjects.
		2x test	Experimenter asks for help (hand extended toward current goal object)	Counterbalanced within subject (between rounds 1 and 2): side of current goal object at test
Choice test round 2	Bear & ball	3x fam	Experimenter reaches for and grasps the original goal object	Counterbalanced between subjects: identity of original goal object, side of original goal object and original object/side pairing
		1x switch scene	Experimenter absent and silent	Congruent condition: For all subjects, objects *do not* switch locations between fam and test. Incongruent condition: timing of object location change between fam and test (round 1 or round 2) counterbalanced between subjects.
		2x test	Experimenter asks for help (hand extended toward current goal object)	Counterbalanced within subject (between rounds 1 and 2): side of current goal object at test

Fig. 5. The procedure for Experiment 5.

actions to infer her goal, as she neither looked nor reached toward either object during choice test trials (because she could not see the objects) and expressed ignorance of their new positions.

Toddlers' successful helping in the congruent condition of Experiment 5 suggests that their less appropriate helping in Experiments 2 and 4 did not occur because their desire for novelty, either for themselves or for the actor, led them to disregard the actor's preference for the familiar object. This suggestion is bolstered by the findings of the incongruent condition. If toddlers wished to see the actor reach for the object that she had not previously manipulated, then they should have shown higher rates of giving of the current goal object in the incongruent than in the congruent condition, because the object of the actor's reach on the incongruent test trials had never been manipulated by that actor. Instead, toddlers showed equal rates of giving of the correct object in the two conditions of Experiment 5. Thus, both the negative findings of Experiments 2 and 4 and the positive findings from the two conditions of Experiment 5 suggest that toddlers' failures to give the target object in Experiments 2 and 4 stems from limits on their ability to use the prior goal-directed action of the agent to guide their helping behaviors.

The analyses comparing performance in the congruent and incongruent conditions of Experiment 5 begin to shed

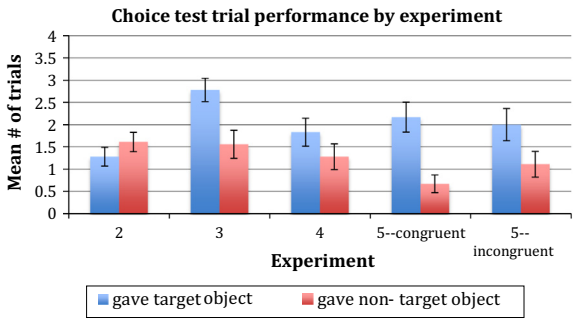

Fig. 6. Performance in the choice test phase across Experiments 2–5.

light on the nature of those limits. In this experiment, we tested whether toddlers can use information gained from an agent's prior goal-directed actions to infer his enduring preferences, and then use those preferences in a situation with greater behavioral support for helping than the situation studied in Experiments 2–4. In Experiment 5, the actor asked for help while both looking at and reaching for an object. If prior goal information influences toddlers' attributions of enduring desires, then this request should have been more compelling for toddlers tested in the congruent condition, in which the current behavior of the actor was congruent with the prior goal and preference information, than in the incongruent condition, in which it was not. Contrary to that prediction, toddlers in the congruent and incongruent conditions of Experiment 5 gave the test target object at similar rates, despite the markedly different history of object-directed reaching shown by the actor. In the incongruent condition, every successful, deliberate act of reaching produced by the actor in familiarization and seen by the toddler was directed to the object that served as the foil at the time of the test. Nevertheless, toddlers were as successful at avoiding this foil, and giving the actor the object of her current reach, in the incongruent condition as in the congruent condition. This finding suggests that 14-month-old toddlers' acts of helping are guided only by information about an actor's current, ongoing actions and perceptions, not by information from her history of goal-directed action.

Thus, the findings of Experiment 5 provide evidence for limits to young toddlers' understanding of desires, of helping, or both. We consider the possible nature of these limits below.

7. General discussion

Although 14-month-old toddlers encode the reaching actions of social agents in terms of object goals (Experiment 1) and use information from a social agent's ongoing goal-directed action to help the agent appropriately by giving her the object that she seeks (Experiment 5), we found a developmental change, from 14 to 24 months, in children's ability to infer, from a social agent's prior goal-directed action, what action to take in response to a request for help. This pattern of development of both desire understanding and prosocial interaction is consistent with existing findings from studies of helping in the second year.

In contrast, evidence from looking-time studies present a mixed picture of younger infants' understanding of preferences and helping: Some studies reveal strikingly appropriate responses to agents' past object choices (Luo & Baillargeon, 2007; Luo & Johnson, 2009) and agents' acts of helping (Hamlin et al., 2013; Martin et al., 2012), whereas other studies reveal sharp limits to infants' understanding of agents' exhibit enduring desires (e.g., Sommerville & Crane, 2009 or second-order goals (e.g., Sommerville & Woodward, 2005).

The present experiments cast doubt on one potential explanation of the discrepancy between infants' and toddlers' successes and failures. Some previous studies using active helping methods presented toddlers with relatively complex events in a rich social environment, in which a variety of objects and activities were available as targets of action and attention. In contrast, many previous studies using looking time methods present infants with simple events involving limited numbers of objects and socially unresponsive agents (whose faces often were out of view or obscured by visors). In those studies, infants might appear to reason more maturely about agents' goals, preferences, and helpful actions in looking time experiments, because the events displayed are extremely simple and easy to parse; they often involve action alone, without complex emotions, language or social interactions. Naturalistic helping studies, on the other hand, tend to be more complex and thus harder for toddlers to process and attend to successfully.

Such an explanation cannot account for the present findings. The active helping studies presented to toddlers in Experiments 2–4 used actions that are identical to those presented to infants in previous looking-time experiments (Woodward, 1998), and to toddlers in Experiment 1. Although the agent in Experiment 1 was socially responsive before and during the study, as she was in the subsequent experiments, toddlers attributed goals to her actions consistently and appropriately. Moreover, the object choice presented to toddlers in the helping task of Experiments 2–4 is the same as that presented in Experiment 5; toddlers successfully gave the correct object in that experiment. Despite these features, 14-month-old toddlers failed to use information about the goal of an actor's prior actions to infer her preferences and thereby guide their own helping behavior. They failed to use this information either in Experiments 2 and 4, in which only prior goal information specified the desired object, or in Experiment 5, in which prior goal information could have been used together with the actor's current behavior, serving to enhance toddlers' choice of actions in one condition and to attenuate that choice in the other condition. Fourteen-month-old toddlers' failure to use information from the actor's prior actions in any of these experiments therefore provides evidence that early failures in active helping tasks cannot be explained by the complexity of the events or tasks. Toddlers fail to use information from past actions to guide their helping, even when the actions are appropriately encoded (Experiment 1) and the

behavioral task of giving out-of-reach objects is readily achieved (Experiment 5).

Could toddlers' failures stem from limits to their understanding of enduring preferences or desires? Experiments by Hamlin et al. (2007, 2010, 2013), Luo (2011), Luo and Baillargeon (2005, 2007), Luo and Beck (2010), and Luo and Johnson (2009) have been interpreted as showing that infants attribute enduring desires to agents, but the evidence for desire understanding in these experiments is indirect, and alternative interpretations of their findings have been offered (Hernik & Southgate, 2012). Studies using active measures of desire understanding have found continued development in this domain during the second year (Chiarella et al., 2013; Wright & Poulin-Dubois, 2012). In the present studies, toddlers appear clearly to discern the desire of an agent who is actively attending to, and attempting to reach, an object (Experiment 5). It is possible, however, that toddlers do not attribute enduring desires to agents: desires that they expect will be maintained as the environment changes. Indeed, recent studies suggest that infants and toddlers do not attribute goals to individuals that endure across time or after changes in their position within the physical environment (Garvin & Woodward, 2014; Sommerville & Crane, 2009). Further research is needed to delineate when infants and toddlers do and do not attribute enduring goals to agents.

A second possible limit concerns toddlers' understanding of helping. The mature concept of helping depends on an understanding of second-order goals: One person intentionally helps another only if the helper's goal is to foster the goal of the person whom she helps. Infants begin to represent second-order goals of a single agent toward the end of the first year, when they first interpret actions (such as opening a box) as aiming to foster further actions (such as taking the object that the box contains) (Sommerville & Woodward, 2005). It is possible that children begin to understand second-order goals that span two social agents even later than those that span a single agent. The evidence for young infants' prosocial evaluations of helpful agents is consistent with that possibility, because those studies do not reveal whether young infants attribute second-order goals to agents whose actions benefit others, or whether they view agents as helpers whenever their intentional, perceptually guided actions result in benefits to others (Hamlin, 2013) or appropriately match the characteristics of others' actions (Powell & Spelke, 2014).

Lastly, it is possible that toddlers have all of the necessary understanding of goals, desires and helping, but that they lack the cognitive resources to use this understanding so as to generate helpful actions. A recent eye-tracking study found that infants took longer to make goal-based action predictions than location-based predictions, suggesting that even passive reasoning about goals is cognitively demanding for infants (Krogh-Jespersen & Woodward, 2014). Furthermore, the difficulty of generating one's own acts of helping may stem from the demands that tasks requiring controlled actions place on processes of inhibitory control and executive function. This hypothesis gains plausibility from research in a different domain, concerning the development of representations of objects. Very young infants represent objects as existing and moving continuously whether in or out of view (Baillargeon, 1987; Baillargeon, Spelke, & Wasserman, 1985), but older children fail to engage in systematic patterns of manual search to retrieve such objects (Piaget, 1954). Indeed, even 2-year-old children sometimes fail to use knowledge of a hidden object's position and motion to search for such an object appropriately (see Keen, 2003 for review). When presented with an event in which a ball rolls behind an occluder toward a solid wall, infants expect the ball to roll continuously to the wall if unobstructed, but expect the ball to stop rolling if it contacts a barrier that has been placed in its path. That is, even very young infants expect objects to adhere to the physical principles of solidity and continuity. 2.5-year-old children, however, fail at an action-based version of this task which requires them to search for the ball once the event is concluded: Children sometimes reach for the ball on the wrong side of the barrier, behaving as if they expected the ball to violate the continuity and solidity constraints. Research by Keen (2003) reveals that this discrepancy stems from the action task's demand for both prediction and action planning. When given a looking-time version of the search task they fail, 2.5-year-old children succeed at the task: They look longer when the door is opened to reveal the same rolling ball stopped on the far side of the barrier rather than in front of it, providing evidence that they represented the correct position of the ball. Thus, the same cognitive capacities of working memory (Munakata, McClelland, Johnson, & Siegler, 1997) and inhibitory control (Diamond, 1990), might mediate the developmental changes in the domains of object and social cognition.

This hypothesis might explain why toddlers fail to take account of the actor's prior goal in the incongruent condition of Experiment 5: The presence of information for a conflicting current goal might compete with their weaker representation of the past goal. Nevertheless, the hypothesis cannot easily explain the contrasting findings of Experiment 1, in which toddlers successfully used the past goal information in analyzing the actor's current behavior, and Experiments 2 and 4, in which they did not. In the latter studies, there was no conflict between the current and past locations of the objects, because both objects appeared in new positions at test. Moreover, there was no conflict between the current and past actions of the experimenter, because the experimenter expressed ignorance of the goal object's position and reached in a neutral direction midway between the objects. The present findings therefore suggest that toddlers have limited understanding of agents' enduring goals and preferences, of the second-order social goals that guide instrumental acts of helping, or both.

In summary, the present findings provide evidence for a significant developmental change in children's helping, over the second year, allowing 24-month-old children but not 14-month-old toddlers to help appropriately a person who requests an object that she has previously been seen to choose. Moreover, they provide evidence that the change involves at least some cognitive factors and is not purely motivational: there are limits to children's understanding of enduring goals, of helping, or both. Studies of

such limits, and of the cognitive changes by which children overcome them, may shed light not only on the developmental mechanisms that underpin the emergence of children's prosocial behavior but also on the development of more general conceptions of persons and their mental states. We hope that the present methods will prove useful for this effort.

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