Research Article

Psychological Science
2015, Vol. 26(3) 274–283

DOI: 10.1177/0956797614562452
pss.sagepub.com

# 13-Month-Olds' Understanding of Social Interactions

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**Abstract**

In the present research, we investigated how 13-month-olds use their emergent theory-of-mind understanding (i.e., understanding about other people's mental states, such as their intentions, perceptions, and beliefs) and social-evaluation skills to make sense of social interactions. The infants watched three puppets (A, B, and C) interact. The results showed that after seeing Agents A and B interact in a positive manner, infants expected them to continue doing so, even after they saw B hit another agent, C, while A was absent. When A was present to witness B's harmful action, however, infants expected A to change his or her behavior and ignore B. Therefore, infants seemed to consider A's perspectives when predicting A's actions. Furthermore, if B accidentally hit C when A was present, infants seemed to accept that A could interact or not interact with B, which suggests that they had taken into account B's intention in their interpretations of the agents' interactions.

**Keywords**

theory of mind, social cognition, infant development

Received 12/12/13; Revision accepted 11/5/14

In the social world, people constantly gather information to evaluate others (e.g., whether or not someone is friendly), which influences how one interacts with another (e.g., approaches or avoids someone). The information includes understanding other people's mental states (i.e., possessing a *theory of mind*), such as their intentions and beliefs, as well as assessing others' personality traits on the basis of observations of behavior. Unfortunately, the information on which social evaluations are based is not always accurate. When using limited information, one may hold false beliefs about others and form erroneous evaluations, which in turn affect social interactions. For example, most children are unlikely to play with a naughty child who hits others or takes others' toys (Parker & Asher, 1987). When some children have not seen this child's transgression, however, and instead falsely believe that he or she is not mean, they may play with him or her, until they personally see the transgression happen and then change how they interact with the naughty child (e.g., Asher & McDonald, 2009; Hymel, Vaillancourt, McDougall, & Renshaw, 2002).

To comprehend this situation, both a theory of mind and social-evaluation skills are necessary. Recent research shows that these social-cognitive capacities emerge early in infancy. For the present study, we thus designed a situation similar to that described above to examine how infants make sense of social interactions.

Adults use a coherent construct of mental states, including intentions, perceptions, beliefs, and false beliefs, to understand each other. False-belief understanding is particularly crucial because it elucidates that other people's minds are representations of the world, rather than direct copies, and hence can be false (Wellman, Cross, & Watson, 2001). Many researchers have shown that even infants ascribe to agents (i.e., entities that can act and react to the environment) intentions, perceptions, and beliefs as underlying reasons for their behavior (the *mentalistic account*; for a review, see Luo & Baillargeon, 2010). Recent data also suggest that infants may understand other people's false beliefs, although this interpretation is still controversial (for reviews, see Baillargeon, Scott, & He, 2010; Heyes, 2014; Perner &

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Roessler, 2012). For example, Onishi and Baillargeon (2005) tested 15-month-olds using a looking-time procedure commonly employed to explore infants' knowledge (e.g., Baillargeon, 1986; Woodward, 1998). They found that infants acted as if they expected a human agent to search for a toy where the agent believed it was located (where the agent had hidden the toy), as opposed to the toy's actual location (where the toy had moved during the agent's absence), and that the infants responded with prolonged looking when their expectation was violated.

However, in false-belief tasks with infants and young children, the content of an agent's belief is usually about physical aspects of a situation (Killen, Mulvey, Richardson, Jampol, & Woodward, 2011), for example, the presence or absence of an object, or its location or identity (e.g., Buttelmann, Carpenter, & Tomasello, 2009; Kovács, Téglás, & Endress, 2010; Luo, 2011; Scott & Baillargeon, 2009; Southgate & Vernetti, 2014; Surian, Caldi, & Sperber, 2007). Tasks probing infants' theory of mind, including false-belief understanding, should certainly include more social situations, because the main reason people attempt to understand one another is to better interact with them. The present study is the first to use a situation in which an agent's false belief is about a social aspect of the situation—in particular, the agent's interaction partner. Demonstrating that infants can comprehend various kinds of situations involving other people's false beliefs can provide strong evidence for the mentalistic account of early false-belief understanding (Luo, 2011; Perner, 2010).

Adults also make sense of people's behavior to evaluate them and to interact with one another. Research on early social-evaluation skills has found that infants can differentiate prosocial from antisocial agents and expect them to be treated differently by other agents (e.g., Kuhlmeier, Wynn, & Bloom, 2003). For example, after watching events depicting Agent A trying to climb a hill while being helped by Agent B, who pushed A up, or while hindered by Agent C, who pushed A down, 10-month-olds expected A to approach B but not C; they themselves also approached B more often than C when presented with both agents (Hamlin, Wynn, & Bloom, 2007). Additionally, infants can take into account an agent's mental state in their social evaluations. Eight-month-olds seem to consider the agents' intentions more important than outcomes; they preferred a helper who failed (with a negative outcome) over a hinderer who failed (with a positive outcome; Hamlin, 2013). Ten-month-olds also considered the agents' knowledge states; they preferred a knowledgeable helper over a nonhelper but did not differentiate between ignorant agents (Hamlin, Ullman, Tenenbaum, Goodman, & Baker, 2013).

Moreover, infants already possess nuanced social-evaluation skills. In a study with 8-month-olds (Hamlin, Wynn, Bloom, & Mahajan, 2011), the prosocial and antisocial agents (animal puppets) again helped or hindered one agent's goal-directed behavior. Next, when the helper or the hinderer played with a ball and dropped it, a third party (a new agent) gave back the ball (giver) or took it away (taker). Infants chose the giver over the taker in the prosocial-agent condition but the taker over the giver in the antisocial-agent condition. They seemed to judge that one should act positively toward prosocial agents but negatively toward antisocial ones.

In Hamlin et al. (2011), the third party had no information about which agent was prosocial or antisocial. Infants actually looked for a similar amount of time at the event in which the ball was given back and the one in which it was taken away, although their choices differed in the two conditions. In real life, a third party may already have a relationship with or an attitude toward other people who are prosocial and antisocial. For instance, how would relatives or friends react to their loved ones' transgressions? We thus examined a situation in which the third party was no longer neutral. Specifically, if the third party had been interacting positively with the agent, would he or she treat that agent differently after seeing the agent perform a harmful act? Because infants seem to feel that antisocial agents should be avoided or their actions punished, the answer might be positive. Additionally, would infants' predictions differ if the third party did not witness the harmful act and held a false-belief about the antisocial agent? On the basis of previous results that infants expect a knowledgeable but not an ignorant third party to reward only a fair agent (Meristo & Surian, 2013), the answer might also be positive.

In the present study, 13-month-olds saw interactions among three hand puppets (A, B, and C). Both false-belief understanding and social-evaluation skills have been found in infants younger than 12 months old (e.g., Hamlin et al., 2007; Luo, 2011). We chose an older age group because of the novelty and complexity of the present task.

In a true-belief condition (see Fig. 1), infants first received familiarization trials in which Puppets A and B interacted in a positive manner: They clapped hands or hopped synchronously, turned to face each other, and wiggled as if laughing together (their mouths were wide open, which gave the impression of laughter). These actions were somewhat similar to positive interaction events used in a previous study, in which two human agents turned to face each other, smiled, waved, and said "Hi" (Liberman, Kinzler, & Woodward, 2014). Next, in an orientation trial, B faced C, hit him or her, and C fell while A watched motionlessly (A was outside the "crime scene" and hence could not intervene if he or she had wanted to). During the test trials, A returned and either acted again in a positive manner with B (oriented toward

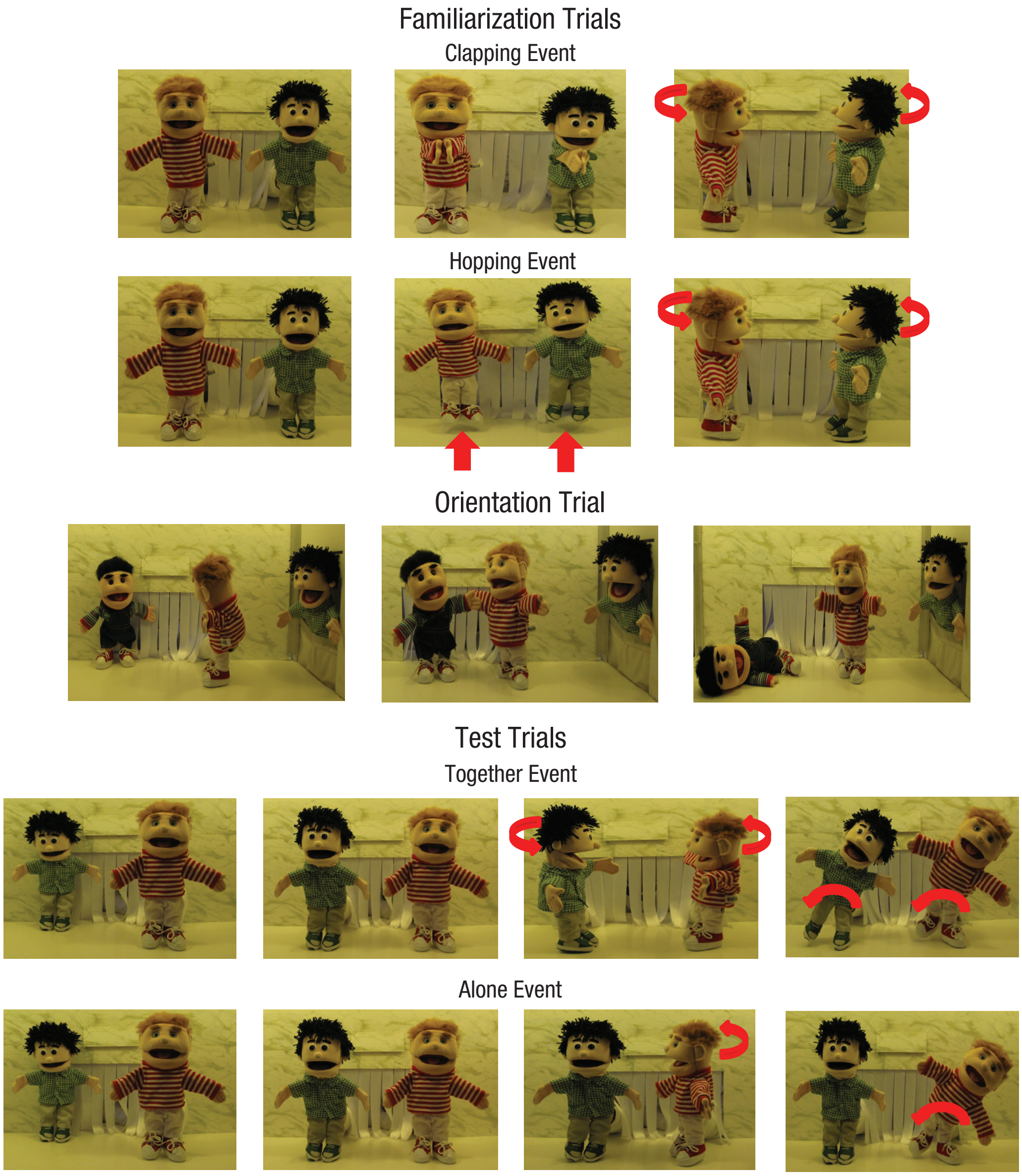


**Fig. 1.** Photographs of the events shown in the familiarization, orientation, and test trials in the true-belief condition. In familiarization trials, Puppets A and B either clapped or hopped together, and then they turned to face each other and wiggled as if laughing. In the subsequent orientation trial, a new puppet, C, approached and was deliberately knocked down by B while A observed. In test trials, A returned, and either A interacted with B (together event) or B acted alone (alone event).

each other, wiggled together, and then swayed simultaneously; together event) or ignored B (alone event). If infants expected A to interact differently with B after seeing B's harmful act, they should respond with heightened interest to the together event. A false-belief condition was identical, except that A was absent during the orientation trial (see Fig. 2). Because A did not witness B's harmful behavior and should hold the same belief that B was his or her "play"[1] partner despite B having harmed C, infants should expect A to still interact with B and hence respond with prolonged looking to the alone event. Note that the together event was perceptually more engaging than the alone event. We expected, however, opposite results from the true-belief and the false-belief conditions.

A third condition, the accidental condition, was created to control for the possibility that A's presence during the orientation trial led to the results of the true-belief condition. The accidental condition was similar to the true-belief condition, except that during orientation, B faced away from and accidentally hit C while stretching his or her


**Fig. 2.** Photographs of the events shown in the orientation trial of the false-belief and accidental conditions. In the false-belief condition, C approached and was deliberately knocked down by B, but A was not present. In the accidental condition, C approached and was accidentally knocked down by B while A observed. Familiarization and test trials in the false-belief and accidental conditions were the same as in the true-belief condition.

arms (see Fig. 2). Although A was present in the orientation trial of both the true-belief and accidental conditions, we expected different results from the two conditions. This was because even at 9 months, infants seem to possess nuanced intention-reading abilities: For example, in a previous study, they reacted differently when an agent deliberately kept a toy from them or teased them with it than when she accidentally dropped the toy (Behne, Carpenter, Call, & Tomasello, 2005). Three-year-old children also separate intentions from outcomes when viewing agents' antisocial behavior: They distinguish between an agent who accidentally harms others (e.g., by unintentionally tearing one's drawing) and one who aims to do so but fails (Vaish, Carpenter, & Tomasello, 2010). In the present study, the outcome of B's action during the orientation trial was the same in the true-belief and the accidental conditions. If infants were sensitive to B's intentions, however, the two conditions should yield different results.

## Method

### Participants

Participants were 48 full-term infants (23 male, 25 female; mean age = 12 months, 23 days; range = 11 months, 21 days–14 months, 11 days). Sixteen infants each were randomly assigned to the true-belief (8 male, 8 female; mean age = 12 months, 23 days), the false-belief (7 male, 9 female; mean age = 12 months, 25 days), and the accidental (8 male, 8 female; mean age = 12 months, 19 days) conditions. Another 14 infants were tested but excluded for looking-time differences at test more than 3 standard deviations from the mean of the condition ($n$ = 3), crying ($n$ = 3), looking for the maximum time allowed (60 s) in all test trials ($n$ = 3; e.g., Scott & Baillargeon, 2013), drowsiness ($n$ = 1), inattentiveness ($n$ = 1), being distracted by an older sibling who walked into the room and disrupted the experiment ($n$ = 1), being scared of the puppets ($n$ = 1), or observer error ($n$ = 1).

### Apparatus

The apparatus consisted of a wooden display box (114 cm high × 104 cm wide × 47.5 cm deep) mounted 76 cm above the room floor. The infant sat on a parent's lap and faced an opening (53 cm high × 102 cm wide) in the front of the apparatus. Between trials, a curtain consisting of a muslin-covered frame (61 cm high × 104 cm wide) was lowered in front of the opening. The side walls of the apparatus were painted white, and the floor was made of white foam board. The back wall of the apparatus was made of foam board and covered with beige granite-patterned contact paper. A rectangular fringe-covered window (18 cm high × 7 cm wide) was created in its midsection. A primary experimenter, hiding behind the back wall and wearing a white shirt, used this back window to maneuver the puppets. A rectangular muslin-covered window (31 cm high × 30.5 cm wide) was created in the right-side wall. A secondary experimenter used this window to present Puppet A during the orientation trial of the true-belief and the accidental conditions.

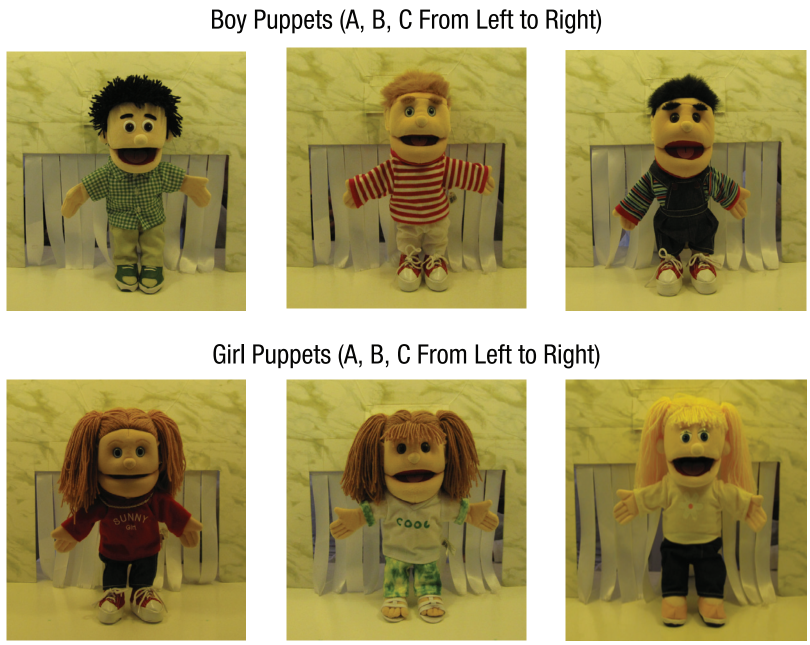


**Fig. 3.** Photographs of the three boy and three girl hand puppets used in the experiment.

Six hand puppets were used (see Fig. 3). They were approximately 35 cm high and 12 cm wide. The puppets differed in hair color and style as well as in their outfit, so that they were easy to discriminate and remember. All puppets depicted were Caucasian children, to avoid skin color being a confounding factor. Half of the 48 infants (13 male, 11 female) saw boy puppets, and the other half saw girl puppets.

## Procedure

Infants in all three conditions first received four familiarization trials alternating between two events. In a clapping event, Puppets A and B clapped their hands in sync while facing the infant (5 s); they then turned to face each other and wiggled as if laughing (3 s; see Video S1 in the Supplemental Material available online). A metronome beat softly once per second to help experimenters adhere to the scripts. The hopping event was similar except that the puppets hopped instead of clapped together (see Video S2 in the Supplemental Material). The 8-s event cycles repeated until the infant either (a) looked away for 2 consecutive seconds after having looked for at least 8 cumulative seconds or (b) looked for 60 cumulative seconds. Infants watched the clapping event during the first and the third familiarization trials and the hopping event during the second and fourth.

Next, infants received an orientation trial appropriate for their condition. In the true-belief condition, Puppet A's head and upper body were visible through the right-side window. The trial started with a 7-s sequence in which Puppet C walked toward Puppet B, who faced C (5 s). B then deliberately hit C when he or she got close, and C fell to the floor (2 s; see Video S3 in the Supplemental Material). The final scene was then paused, and during this time (the main sequence), infants watched until they either (a) looked away for 2 consecutive seconds after having looked for at least 2 cumulative seconds or (b) looked for 30 cumulative seconds. The false-belief condition was similar to the true-belief condition except that A was absent in the orientation trial (see Video S4 in the Supplemental Material). The accidental condition was similar except that B faced away from C during the orientation trial (see Video S5 in the Supplemental Material).

Finally, all infants were given two pairs of test trials, with each pair consisting of one together and one alone event. In the first 5 s of each trial, A walked toward B. In the together event, B and A turned to face each other and wiggled as if laughing together, as in familiarization (3 s). Then the two puppets turned to face the infant and swayed synchronously (5 s; see Video S6 in the Supplemental Material). The alone event was similar except that A stood facing the infant while B acted alone (see Video S7 in the Supplemental Material). These 8-s event cycles, which constituted the main sequence in test trials, repeated until the criteria to end the trial were met. These criteria were identical to those in the familiarization trials. Roughly half of the infants in each condition (true belief: $n = 9$; false belief: $n = 8$; accidental: $n = 7$)

saw the together event first, and the remainder saw the alone event first. Four of the 48 infants contributed data from the first pair of test trials because they cried ($n$ = 2) or became drowsy ($n$ = 1) in the second pair of test trials or because of observer error ($n$ = 1). In these cases, the second pair of trials was treated as missing data.

Two observers who were naive to the hypotheses of the study monitored each infant's looking behavior through peepholes in large cloth-covered frames on either side of the apparatus. The primary observer's looking times were used to determine the endings of the trials. Interobserver agreement was measured for 30 of the 48 infants, because only the primary observer was present for 18 infants. Interobserver agreement averaged 95% per trial per infant.

Infants were highly attentive during the 7-s portion of the orientation trial preceding the main sequence (mean looking time = 7.0 s) and the 5-s portion of the test trials preceding the main sequence (mean looking time = 4.8 s). Preliminary analyses of test data revealed no significant interactions between condition and event with any combinations of puppet gender, sex, or event order, all $F$s(2, 24) < 1.55, $p$s > .233; data were therefore collapsed across the last three factors in subsequent analyses.

## Results

The analysis of infants' familiarization looking times (see Fig. 4a) revealed a significant interaction between condition and familiarization event (clapping or hopping), $F(2, 45) = 3.67$, $p = .033$, $\eta^2 = .131$. This was because infants in the true-belief condition looked reliably longer at the clapping event ($M$ = 49.3 s, $SD$ = 8.6) presented in the first and third familiarization trials than at the hopping event ($M$ = 40.6 s, $SD$ = 14.2) presented during the second and fourth familiarization trials, $F(1, 45) = 7.83$, $p = .008$, whereas infants did not look for a significantly different length of time at the two events in either the false-belief condition (clapping event: $M$ = 47.3 s, $SD$ = 12.3; hopping event: $M$ = 42.6 s, $SD$ = 12.8), $F(1, 45) = 2.33$, $p = .134$, or the accidental condition (clapping event: $M$ = 46.3 s, $SD$ = 14.2; hopping event: $M$ = 49.3 s, $SD$ = 11.3), $F(1, 45) = 0.94$, $p > .250$. Across the three conditions, infants' mean looking times during the four familiarization trials were similar, $F(2, 45) = 0.38$, $p > .250$, $\eta^2 = .017$ (true-belief condition: $M$ = 44.9 s, $SD$ = 9.0; false-belief condition: $M$ = 44.9 s, $SD$ = 11.3; accidental condition: $M$ = 47.8 s, $SD$ = 11.7).

The analysis of infants' main-trial looking times in the orientation phase revealed that infants in the true-belief condition ($M$ = 25.7 s, $SD$ = 6.9), false-belief condition ($M$ = 22.4 s, $SD$ = 7.7), and accidental condition ($M$ = 25.1 s, $SD$ = 7.6) did not look for significantly different lengths of time, $F(2, 45) = 0.90$, $p > .250$, $\eta^2 = .039$ (see Fig. 4b).

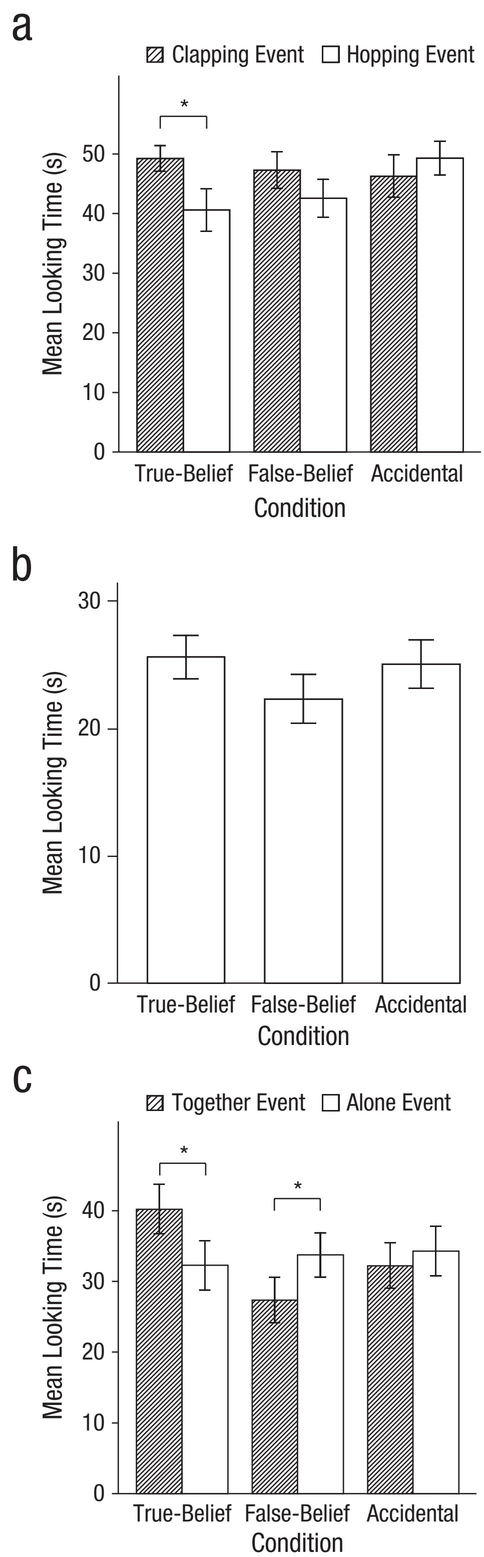


**Fig. 4.** Infants' mean looking time during the (a) familiarization trials, (b) main sequence in the orientation trial, and (c) main sequences in the test trials. For familiarization and test trials, results are shown as a function of event type and condition. For the orientation trial, results are shown for each condition. Error bars represent standard errors. An asterisk denotes a significant difference between events ($p$ < .05).

The infants' main-trial looking times during the test phase (see Fig. 4c) were averaged and analyzed using a $3 \times 2$ repeated measures analysis of variance (ANOVA) with condition (true belief, false belief, accidental) as a between-subjects factor and event (together, alone) as a within-subjects factor. The analysis yielded a significant Condition × Event interaction, $F(2, 45) = 6.55$, $p = .003$, $\eta^2 = .225$. No other effect was significant. Planned comparisons revealed three key points. First, infants in the true-belief condition looked reliably longer at the together event ($M = 40.2$ s, $SD = 13.9$, 95% confidence interval, or CI = [33.4, 47.0]) than at the alone event ($M = 32.3$ s, $SD = 13.9$, 95% CI = [25.5, 39.1]), $F(1, 45) = 7.68$, $p = .008$, Cohen's $d = 0.776$, 95% CI of the difference between mean looking times at the two events = [2.8, 13.1]. Second, infants in the false-belief condition looked reliably longer at the alone event ($M = 33.7$ s, $SD = 12.4$, 95% CI = [27.6, 39.8]) than at the together event ($M = 27.4$ s, $SD = 12.8$, 95% CI = [21.1, 33.7]), $F(1, 45) = 4.91$, $p = .032$, $d = 0.471$, 95% CI = [−0.5, 13.2]. Finally, infants in the accidental condition looked for an approximately equal amount of time at the together event ($M = 32.2$ s, $SD = 12.9$, 95% CI = [25.9, 38.5]) and the alone event ($M = 34.3$ s, $SD = 14.1$, 95% CI = [27.4, 41.2]), $F(1, 45) = 0.51$, $p > .250$, $d = -0.226$, 95% CI = [−6.7, 2.5]. Examination of individual infants' looking times confirmed these results. Twelve of the 16 infants in the true-belief condition looked longer at the together event than at the alone event, whereas 5 infants in the false-belief condition and 8 in the accidental condition did so, $\chi^2(2, N = 48) = 6.18$, $p = .046$, $\varphi = .359$.

Because infants' looking behavior during the familiarization trials differed across the three conditions, the test data were subjected to an analysis of covariance. The factors were the same as in the ANOVA, and the covariates were infants' mean looking times at the clapping and hopping events during the familiarization trials. The results replicated those of the ANOVA: The Condition × Event interaction was still significant, $F(2, 43) = 7.97$, $p = .001$, $\eta^2 = .249$. Planned comparisons confirmed that (a) infants in the true-belief condition looked reliably longer at the together than at the alone event, $F(1, 43) = 10.75$, $p = .002$, (b) infants in the false-belief condition looked reliably longer at the alone than at the together event, $F(1, 43) = 4.50$, $p = .040$, and (c) infants in the accidental condition did not look for a significantly different amount of time at the two events, $F(1, 43) = 1.75$, $p = .193$.

The infants' main-trial looking times at test in the true-belief condition were compared with those in the false-belief condition, and each was compared with the accidental condition using $2 \times 2$ ANOVAs with condition as a between-subjects factor and event as a within-subjects factor. The analysis comparing the true-belief with the false-belief condition yielded only a significant Condition × Event interaction, $F(1, 30) = 10.70$, $p = .003$, $\eta^2 = .262$. Planned comparisons confirmed that infants in the true-belief condition looked reliably longer at the together than at the alone event, $F(1, 30) = 6.61$, $p = .015$, and those in the false-belief condition looked reliably longer at the alone than at the together event, $F(1, 30) = 4.22$, $p = .049$. Critically, infants in the true-belief condition ($M = 40.2$ s, $SD = 13.9$) looked reliably longer at the together event than did those in the false-belief condition ($M = 27.4$ s, $SD = 12.8$), $F(1, 30) = 17.26$, $p < .001$, $d = 0.960$.

The analysis comparing the true-belief with the accidental condition yielded only a significant Condition × Event interaction, $F(1, 30) = 7.99$, $p = .008$, $\eta^2 = .196$. Planned comparisons revealed that infants in the true-belief condition looked reliably longer at the together than at the alone event, $F(1, 30) = 10.08$, $p = .003$, and those in the accidental condition looked for an approximately equal time at the two events, $F(1, 30) = 0.67$, $p > .250$. Critically, infants in the true-belief condition ($M = 40.2$ s, $SD = 13.9$) looked reliably longer at the together event than did those in the accidental condition ($M = 32.2$ s, $SD = 12.9$), $F(1, 30) = 10.21$, $p = .003$, $d = 0.596$.

The analysis comparing the false-belief with the accidental condition did not yield a significant Condition × Event interaction, $F(1, 30) = 1.05$, $p > .250$, $\eta^2 = .030$. Although infants in the false-belief condition looked reliably longer at the alone than at the together event, $F(1, 30) = 4.57$, $p = .041$, those in the accidental condition had only a slight tendency to do so, $F(1, 30) = 0.48$, $p > .250$.

## Discussion

These results suggest the following conclusions. When Agents A and B interacted in a positive manner, 13-month-olds expected them to continue doing so, even though they saw B hit another agent, C, when A was absent. However, when A was present and witnessed B's harmful action, infants expected A to change his or her behavior and ignore B. Furthermore, if it appeared that B hit C accidentally with A present, infants seemed to accept that A might subsequently interact or not interact with B.

This is one of the first studies (Hamlin et al., 2013; Meristo & Surian, 2013) to demonstrate that preverbal infants could use their theory of mind and social-evaluation skills to understand other people's interactions. The true- and false-belief conditions differed only in whether or not A was present when B harmed C, but yielded opposite results. This suggests that infants considered A's perspective to predict A's behavior. If A saw B's harmful action and viewed B as antisocial, A should not interact with B; otherwise, A had a false belief about B and should still "play" with B. Note that in the false-belief condition, infants themselves might have viewed B as punishable on the basis of previous results (Hamlin et al., 2007; Hamlin et al., 2011). The fact that they accepted that A could still interact with B during test indicates that they interpreted the social situations from A's, not their own, viewpoint.

The true-belief and accidental conditions differed only in whether or not B faced C during orientation, but these conditions produced different results. This suggests that infants were sensitive to B's intention when the harmful act happened. In the true-belief condition, it was clear that B intentionally harmed C; infants thus expected the onlooker A to not "play" with B any more, even when A and B initially had positive interactions. In the accidental condition, A saw B cause accidental harm to C. In previous work (Vaish et al., 2010), similar proportions of 3-year-olds chose to help an actor who caused accidental harm to others and one who simply behaved neutrally. By contrast, significantly fewer children helped an actor who caused harm or intended but failed to cause harm to others. Therefore, accidental harm fares differently from harm or intended harm. If this also held true for infants, then those in the accidental condition should have expected A to still interact with B during test because B hit C by accident, and this condition would have yielded results like those of the false-belief condition. Infants tended to do so, but the results were nonsignificant. One possible reason might lie in the nature of the harm. In Vaish et al. (2010), the harm was done to the agent's possession (e.g., her drawing was torn). In the present condition, the harm was done to C him- or herself. Infants thus might have reasoned that A should stay away from B in case the clumsy agent would also cause accidental bodily harm to A during test. Future research will address this possibility.

In sum, the present results extended previous research in at least two ways. First, infants succeeded in a novel false-belief task involving a social situation; A's belief was about whether he or she should or should not interact with B. This contributes to the claim that even infants seem to understand other people's false beliefs, which can be demonstrated in different experimental situations (e.g., Baillargeon et al., 2010). Following our previous work (Luo, 2011), we define false beliefs as beliefs incongruent with reality. Notably, beliefs are derived from perceptual experience (e.g., seeing or hearing about the environment; Wellman & Bartsch, 1988). False-belief tasks with infants and children, including the present task, implement connections among beliefs, false beliefs, and perceptions: An agent who does not witness a critical event holds a false belief. Therefore, seeing leads to knowing, and not seeing leads to not knowing and hence holding wrong or outdated information. In the current false-belief condition, A did not see and hence did not know of B's harmful act toward C. Therefore, A held outdated information or a false belief that it was still appropriate to interact positively with B. An alternative interpretation is that since A was ignorant of B's behavior toward C during orientation, infants simply expected A to continue his or her interaction pattern with B during test. It is admittedly an open question whether this expectation had to involve A's belief about B. However, we preferred the belief-based over the ignorance interpretation for the results from the false-belief condition because of infants' responses in the true-belief and accidental conditions. Results from these two conditions suggest that infants made different predictions on how A should interact with B during test based on A's knowledge states regarding B—A saw and hence knew whether B harmed C on purpose or by accident.

Second, the present study adds to the exciting research on infants' social-evaluation skills. As described previously, infants expect the recipient of a harmful act to avoid the antisocial agent (Hamlin et al., 2007). Further, given a third party naive to an antisocial agent's actions, infants show preference for a third party who acts negatively toward the antisocial agent over a third party who acts positively toward the antisocial agent (Hamlin et al., 2011). Our results suggest that when the third party is partial toward the antisocial agent but sees the harmful act, infants also expect the interaction between them to change. Previous results show that infants also expect the recipient of a helpful act to approach the prosocial agent (Hamlin et al., 2007), and they show a preference for a naive third party who acts positively toward the prosocial agent rather than one who acts negatively (Hamlin et al., 2011). Future research should examine whether, in situations such as those in the present study, infants expect A to "play" with B if A and B initially do not act together but B is revealed to have behaved prosocially toward C, whom A was not previously acquainted with. Previous results in which infants saw both an antisocial agent and a prosocial agent (Hamlin et al., 2007; Hamlin et al., 2011) suggest that they might. The contrast between the two agents might lead infants to hold clear expectations. Another possibility is that infants had no clear expectations about what A should do with a prosocial B if A and B do not initially interact in a positive manner. After all, adults do not always become friends with every single nice person they meet. The formation of friendships needs more than someone being nice; for example, there must be shared interests or preferences.

In the present true-belief condition, A and B interacted positively during familiarization, and then A saw B hit C during orientation. An interesting question is how A should treat C if they were involved during test. One possibility is that A might be "nice" to C and "play" with him or her because C just suffered some harm. Some new findings offer another possibility. Recent studies show that infants and preschoolers can predict an agent's behavior on the basis of experiences of the agent's social-interaction partner (e.g., Chalik & Rhodes, 2014; Rhodes, Hetherington, Brink, & Wellman, in press). For example, after watching A and B cooperate but A and C engage in conflict, 16-month-old infants expect B to also engage in conflict with C (Rhodes et al., in press). This leads to the prediction that if the positive interaction between A and B in the present study had similar predictive power as a cooperative interaction, then A might not be so "nice" to C and ignore him or her.

How should we characterize the interactions between A and B during familiarization? Recently, researchers started to examine infants' expectations about social relations, focusing on dominance (Mascaro & Csibra, 2012; Thomsen, Frankenhuis, Ingold-Smith, & Carey, 2011). Twelve- and 15-month-olds judge the dominance relationship between two agents to persist in different situations (Mascaro & Csibra, 2012). If social relations are defined as an interaction pattern between two agents that happens across time and context, then our familiarization phase might show that A and B had a positive relation. They engaged in two actions (clapping hands and hopping) synchronously and also turned to face each other and wiggled as if laughing with each other. The results suggest that infants expected the two "friends" to interact positively again, engaging in a different action (swaying), unless one saw the other commit an antisocial act. Therefore, infants may be able to judge the valence of social relations (positive vs. negative, dominance or possession), as they evaluate social interactions or one agent's behavior. The preparations for young children to venture into and deal with different relations (e.g., parent-child, sibling, or peer relationships; Dunn, 2002; Hay, Caplan, & Nash, 2009; Russell, Mize, & Bissaker, 2002) may start earlier than previously thought.

## Author Contributions

Y. Choi developed the study concept, analyzed the data, and drafted the manuscript under the guidance of Y. Luo. Both authors were involved in study design and data collection and approved the final version of the manuscript for submission.

## Acknowledgments

We thank Kris Onishi for helpful suggestions, three reviewers for their insightful comments, the University of Missouri Infant Cognition Laboratory for their help with data collection, and the parents and infants who participated in the research.

## Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

## Supplemental Material

Additional supporting information can be found at http://pss.sagepub.com/content/by/supplemental-data

## Note

1. Throughout the article, we use quotes for "play" and "friends" because it is unknown whether such adult concepts are understood by infants.

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