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Infants Understand Others' Needs

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Abstract

Infants begin to help other individuals in the second year of life. However, it is still unclear whether early helping behavior is based on an understanding of other individuals' needs and is thus motivated prosocially. In the present eye-tracking study, 9- to 18-month-old infants ($N = 71$) saw a character in need of help, unable to reach its goal because of an obstacle, and a second character that was able to achieve a goal on its own. When a third individual (a helper) initiated an action, the infants expected the helper to help the character in need (as indicated during the anticipatory-looking and violation-of-expectation phases). Their prosocial understanding did not differ between age groups and was not related to their helping behavior (measured in two behavioral tasks). Thus, infants understand other individuals' needs even before they start to help others themselves. This indicates that early helping may indeed be motivated prosocially and raises the question of which other competences underlie the ontogeny of helping behavior.

Keywords

infant cognition, eye tracking, prosocial behavior

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Infants begin to help other individuals in the beginning of the second year of life. First, they pass objects to other individuals who cannot reach the objects (Warneken & Tomasello, 2007); later, they acquire the ability to help others in a variety of more complex situations at around 18 months of age (Warneken & Tomasello, 2006). The authors proposed that early helping behavior reflects humans' natural prosocial tendencies (Warneken & Tomasello, 2006, 2009). This interpretation presupposes that infants understand the needs of other individuals from early on and orient their behavior toward these needs to benefit the other individual (Eisenberg, Fabes, & Spinrad, 2006; Hoffman, 1981). However, helping behavior in situations in which an object is out of reach may be explained more conservatively: First, helping behavior could rely on a general interest in other individuals' activities and the motivation to socially engage with others (Carpendale, Kettner, & Audet, 2014; Hay, 2009; Paulus, 2014). Second, infants' helping behaviors could rely on a contagion process with other individuals' intentions and merely aim at finalizing a goal-directed but incomplete action (Barresi & Moore, 1996; Kärtner, Keller, & Chaudhary, 2010; Kenward & Gredebäck, 2013). Thus, the cognitive and motivational processes underlying early helping behavior are not well understood.

The critical question is whether infants do understand other individuals' needs when they begin to engage helpfully. Infants' can understand the goal-directedness of animate actions from the age of 6 months on (Woodward, 1998): They expect that human hands (but not inanimate objects, e.g., garden tools) will reach toward a previously touched toy rather than a previously reached-for location. From early on, infants use their understanding of goal-directed actions to evaluate other individuals (Hamlin, Wynn, & Bloom, 2007): Already, 6-month-olds prefer individuals who support other individuals' goal-directed actions (helpers) over individuals who obstruct goal-directed actions (hinderers). Shortly thereafter, infants further understand the intentions underlying goal-directed behaviors at around 9 months of age (Behne, Carpenter, Call, & Tomasello, 2005; Woodward, 1999). For example, 9- to 18-month-olds, but not 6-month-olds,

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show more impatience if an individual is unwilling to give them a desired object than if he or she is unable to give them a desired object (Behne et al., 2005). However, the age at which infants begin to understand that other individuals' not only follow goals but are in need of help (i.e., that they are unable to achieve an intended goal on their own) has not been investigated. Furthermore, it is an open question whether the emergence of infants' helping behavior in the second year indicates a maturing understanding of other individuals' needs. Alternatively, infants may not yet understand other individuals' needs when they begin to help, as suggested by the alternative explanations noted previously, or their prosocial understanding may emerge even earlier.

In the present study, we used eye-tracking measures to investigate 9- to 18-month-old infants' understanding of the needs of other individuals. Two characters were displayed simultaneously on either side of the screen, both interacting with a ball. One character was unable to reach the ball because of an obstacle (character in need); the other character was able to reach a ball on its own (character not in need). When a helper leaned forward, we tested whether infants would look first at the character in need (i.e., anticipatory looking), indicating the anticipated action of the helper. In addition, the helper gave the ball either to the character that was in need or to the other character, which did not require help (i.e., violation of expectation), to further test whether infants would expect helping behavior directed toward the character in need. To investigate how infants' understanding of other individuals' needs relates to their helping behavior, we further assessed infants' behavior in two situations in which an object was out of reach.

Method

Participants

Participants were 71 healthy infants between 9 and 18 months old, in three age groups: 9- to 11-month-olds (n = 21, 12 female; mean age = 10.5 months, SD = 0.8), 12- to 14-month-olds (n = 25, 11 female; mean age = 13.2 months, SD = 1.0), and 15- to 18-month-olds (n = 25, 11 female; mean age = 16.7 months, SD = 1.2). Data from 11 additional infants were excluded from the eye-tracking analysis because of procedural errors (n = 3) or insufficient eye-tracking recordings (less than 70% of the presentation time; n = 8). Data from 2 further infants were excluded from the behavioral analysis because of procedural errors. Participants were recruited in collaboration with local institutions offering courses for mothers. Sample size was determined by the number of infants that could be recruited in these courses. The study was carried out in accordance with the provisions of the World Medical Association Declaration of Helsinki, and informed written consent was obtained from one parent of each infant.

Stimulus material

We designed six animated picture stories in which a character in need was separated from a ball by an obstacle, along with a second character that was able to reach a ball (see Fig. 1). The characters consisted of colored shapes, arms, legs, and googly eyes. Each picture story comprised an initial familiarization phase and two critical test phases (anticipatory looking and violation of expectation; see Fig. 2 and the Supplemental Videos in the Supplemental Material available online). During the familiarization phase, both characters entered the scene and played with a ball before the scene faded out. In a second scene, both characters entered and reached out for a ball unsuccessfully because they were separated from the ball by an obstacle (see Figs. 2a and 2b). This illustrated the intention of both characters to reach for and to play with a ball. Before the start of the test phases, a human-like agent (the helper) appeared in the background of the scene and remained there for 3 s for an initial familiarization. Subsequently, a character entered the scene and was separated from the ball by an obstacle, and, at the same time, another character entered the scene and was able to reach the ball on its own (see Fig. 2c), as in the familiarization phase. The characters stopped in front of the obstacle (character in need) or the ball (character not in need) and remained there for 3 s to familiarize the infants with the setup.

In the anticipatory-looking phase, the helper looked at both characters in turn before he leaned forward; the scene stopped for another 3 s to allow us to test the infants' anticipation of the helpers' action (anticipatory looking; see Fig. 2d). Finally, the helper helped either the individual in need or the individual not in need to reach the ball (violation of expectation; see Figs. 2e and 2f and the Supplemental Videos in the Supplemental Material). The scene remained for 3 s to assess the infants' looking times. To grab and sustain their attention, we underlaid the picture stories with sounds for the characters and the helper. Furthermore, to accentuate the difference between the picture stories, the shapes and colors of the characters as well as the color of the helpers' clothing and hair were varied across trials.

We used a within-subjects design so that each infant saw all six picture stories; in these stories, different obstacles separated the character in need from the ball (e.g., a long brick, a gap in the ground; see Fig. 1). There were three trials of each condition (expected, unexpected). Furthermore, the picture stories were pseudorandomized and counterbalanced for several aspects: the order of the six picture stories, the order of the violation-of-expectation

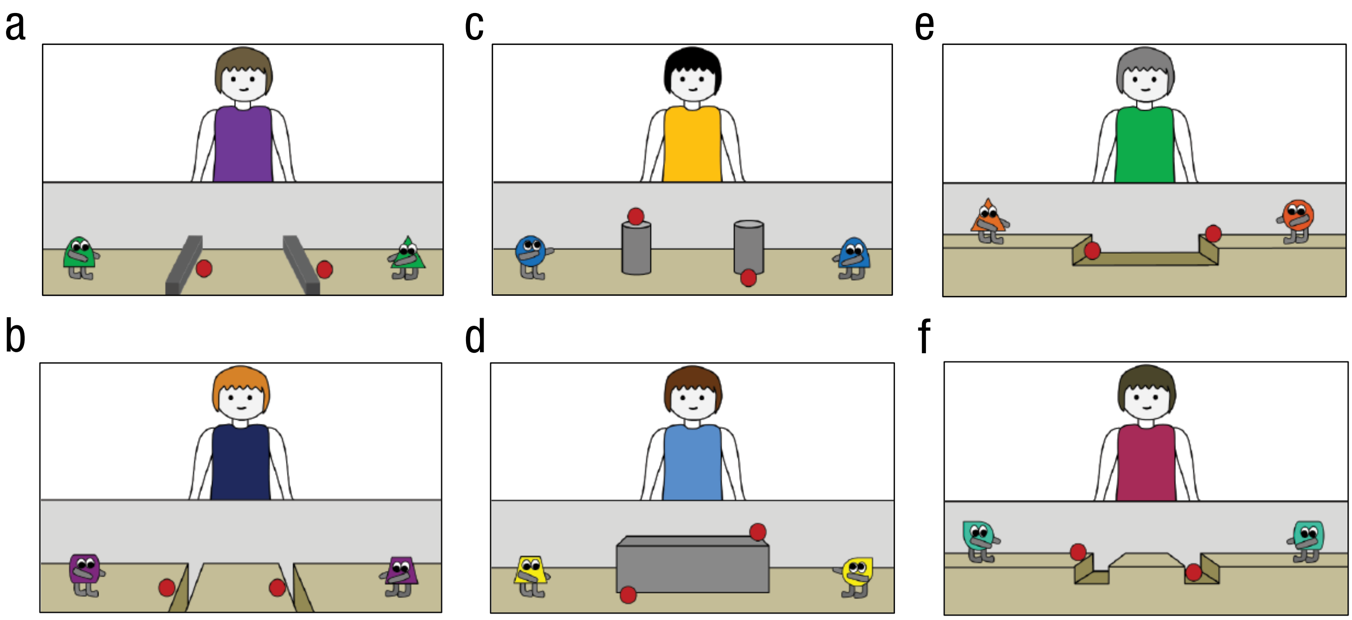

Fig. 1. Screenshots from the six picture stories shown to the infants. In each story, there was a helper (at the center) and two characters (on either side of the helper). One character was able to reach the ball on its own, but the other character was blocked from the ball by one of various obstacles: (a) a long brick, (b) a gap in the ground, (c) a tall cylinder, (d) a wall, (e) a large ditch, or (f) a small ditch. Along with the obstacles, the colors of the characters and the helper's hair and clothes changed from story to story.

condition (expected, unexpected), the shape and color of the characters, the side of the screen on which the character in need appeared (left, right), the order of the familiarization trials (reach first, play first), as well as the sounds made by the characters during reaching and playing ("hmm, hmm, hmm," "hee, hee, hee").

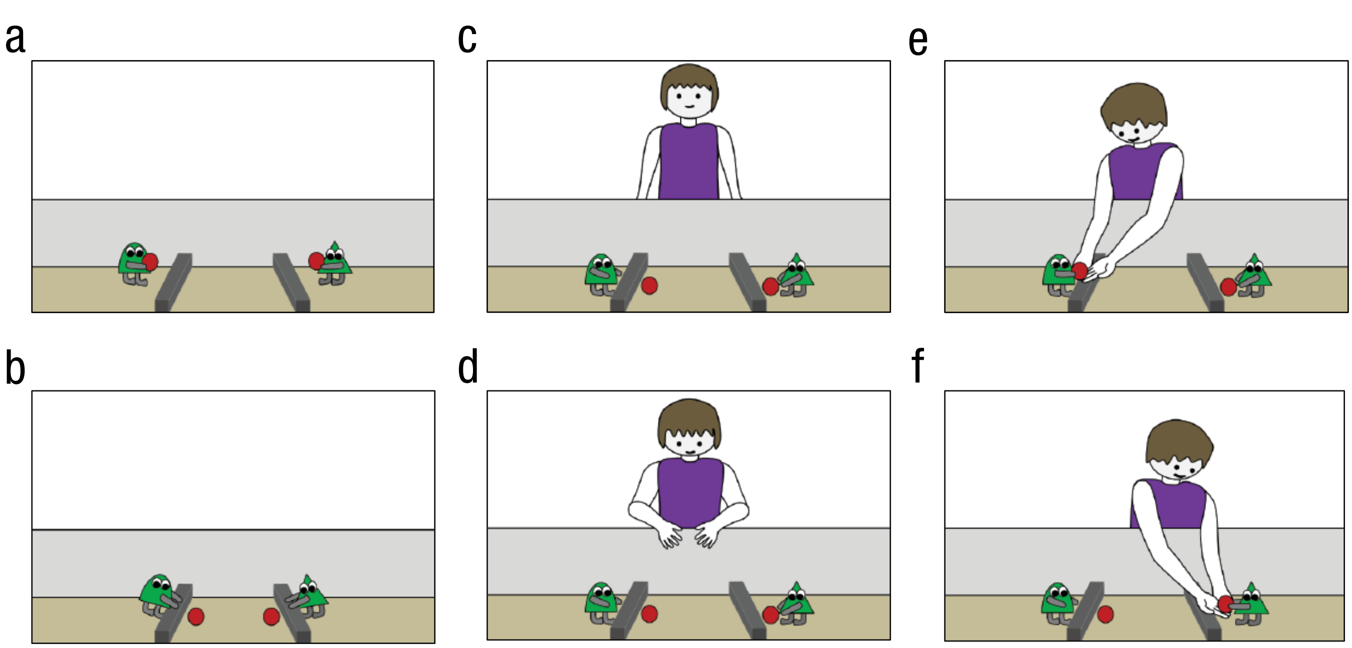

Fig. 2. Sample picture-story sequence. In the familiarization phase (a), two characters entered the scene, picked up the balls in front of them, and played with them, jumping up and down, and the scene faded out. The characters then entered the scene a second time (b). This time, both balls were placed behind obstacles, and the characters reached out for them unsuccessfully, and the scene faded out. Before the characters entered the scene again, a helper appeared in the background. This time, an obstacle prevented one character (character in need) from reaching the ball, but the other character (character not in need) was able to reach the ball (c). In the anticipatory-looking phase (d), the helper looked to both sides and then leaned over to engage in the scene. The scene then paused to provoke anticipatory-looking behavior. For the violation-of-expectation phase, in half of the trials, the helper helped the character in need (expected condition; e); in the other half of the trials, the helper helped the other character, which was able to reach the ball on its own (unexpected condition; f).

In a control condition, the infants saw another picture story in which geometrical shapes were used, but they were missing the arms, legs, and googly eyes used in the experimental condition (see Fig. 3). Furthermore, the shapes did not enter the scene but were already in place as the scene began (to prevent the infants from interpreting the shapes as having an intention). Except for these differences, the phases of the control trials paralleled those of the experimental trials. This control condition was designed to control for the possibility that the effects might be explained by visual differences in the two different configurations of geometrical shapes (character in need, character not in need). Such differences might include the distance between the two shapes or the harmonic movement of both shapes in the play sequence of the familiarization phase. To avoid associations with the experimental trials, we showed the control trial to each participant at the beginning of each session, before the presentation of the experimental trials; the infants saw either an expected or an unexpected outcome in the violation-of-expectation phase.

Eye-tracking procedure and analysis

Each infant sat on his or her parent's lap, 60 to 70 cm from the 20-in. computer screen (47.6 × 32.9 cm; resolution: 1,680 × 1,040 pixels) on which the stimuli were presented. Lights in the laboratory were dimmed. Participants' gaze was tracked with a remote eye-tracking unit (Tobii X1; Tobii Technology, Stockholm, Sweden), at a sampling rate of 28 to 32 Hz. Before the start of the experiment, we verified that the eye tracker could not track the eyes of the parent and carried out a nine-point calibration.

Individual fixations were defined using a velocity-threshold identification filter implemented in Tobii Studio (Version 3.2); they were then exported for further analysis in MATLAB (Version R2013a; The MathWorks, Natick, MA). We defined three regions of interest (ROIs) around the relevant elements of the scene: an ellipsis around the helper and a rectangle around each character. We removed any areas of ROI overlap. After we included all trials with at least one valid fixation into one of the ROIs for each of the experimental phases, an average of 5.7 of 6 trials remained for the analysis of first fixations and 5.6 of 6 trials for the violation-of-expectation analysis. In the control condition, all but two trials in the anticipatory-looking phase could be analyzed.

For the analysis of the anticipatory-looking phase, we took the first fixation into one of the ROIs of the two characters (in need, not in need) within the 3-s time window after the helper bent over to engage in the scene. The number of first fixations is reported as a percentage of all valid trials. As a looking-time measure in the final scene, we summed the duration of all fixations that fell into any of the three ROIs from the moment the helper

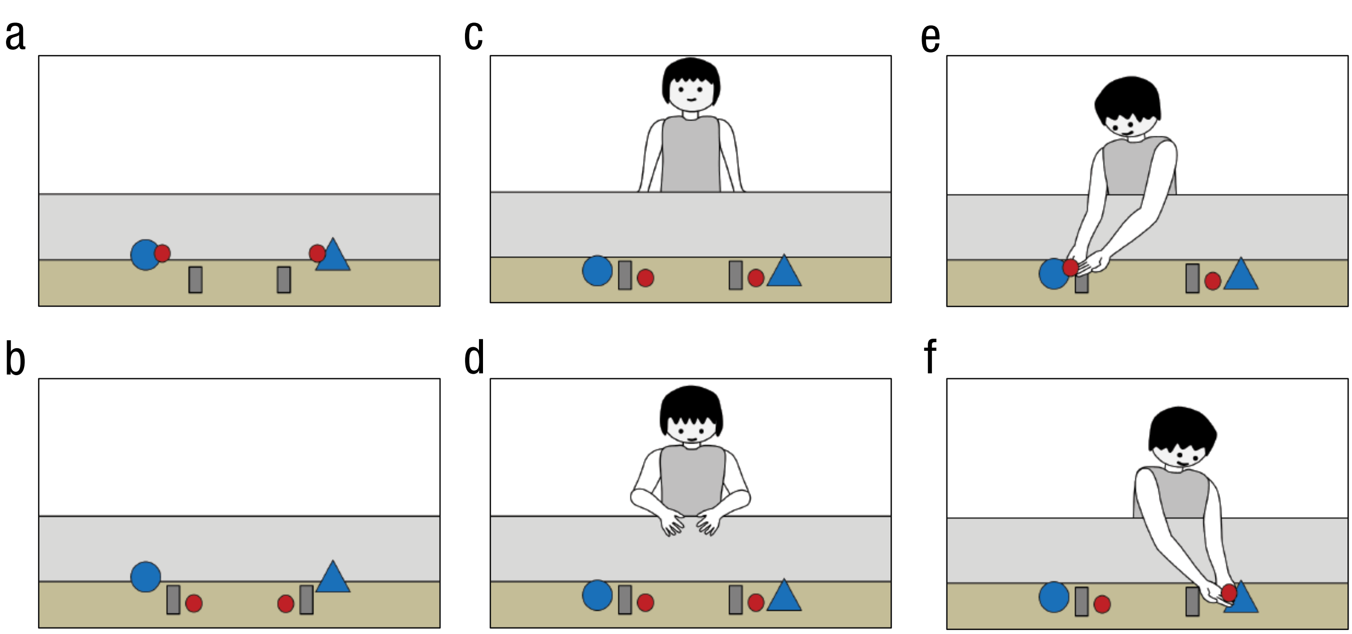

Fig. 3. Illustration of the control trials. The shapes, the general configuration of the scene (a–c), and the helper's behavior in the control trials resembled those used in the experimental trials (see Fig. 2). In contrast with the experimental trials, the shapes did not have arms, legs, or googly eyes. The shapes did not enter the scene and move toward the balls, as they did in the experimental condition. These changes were made to avoid the interpretation that the shapes had intention. Finally, the helper's behavior was identical to that in the anticipatory-looking phase (d) and the violation-of-expectation phase (e and f) of the experimental trials.

took the ball and through the 3-s still frame, when the ball was passed over. Fixation times were averaged over the trials of each condition (expected, unexpected).

Behavioral tasks

After the eye-tracking assessments and a free-play interaction with the experimenter, the infants' helping behavior was assessed in two out-of-reach tasks adapted from earlier studies. In the first task (Hepach, Vaish, & Tomasello, 2012), the experimenter stacked plastic cups on a table, then successively dropped three cups on the ground and reached out for them. For each cup, the experimenter kept his gaze on the cup for the first 10 s and then alternated his gaze between cup and child for the final 10 s. In a second task (Kärtner, Schuhmacher, & Collard, 2014), the experimenter and the infant faced one another across a table. Each had three cups placed in front of him or her, positioned such that neither could reach the cups on the other side. The experimenter started to collect the cups on his side of the table, saying "I will now start to collect the cups," and then reached for the cups on the infants' side of the table. Again, the experimenter kept his gaze on the cup (first 10 s) before he alternated his gaze between the cup and the child (last 10 s). The percentage of cups the infant passed to the experimenter within 20 s was coded for each task and integrated into an average score. Interrater agreements were assessed for 25% of the data (Task 1: Cohen's $\kappa = .79$, Task 2: Cohen's $\kappa = .92$).

Statistical analysis

Mixed-model analyses of variance were used to analyze first fixations in the anticipatory-looking phase and the fixation duration in the violation-of-expectation phase: The factors for the anticipatory-looking phase were age group (9–11, 12–14, and 15–18 months) and ROI (character in need, character not in need); the factors for the violation-of-expectation phase were age group (9–11, 12–14, and 15–18 months) and condition (expected, unexpected). The control trial was analyzed by means of a binominal test for the number of first fixations in the anticipatory-looking phase and by an analysis of variance for the fixation duration. We used the same factors as in the experimental condition, but condition was a between-subjects factor because of the single control trial shown to the infants. To analyze the relation between indicators of prosocial understanding and helping behavior, we calculated Pearson's correlation between the helping score and the differential between the infants' anticipatory fixations (percentage of first fixations on character in need minus percentage of first fixations on character not in need) and looking times in the last scene (fixation duration in the unexpected condition minus fixation duration in the expected condition). All main effects and interactions that are not reported were nonsignificant. All reported p values are two-tailed.

Results

The infants in all three age groups expected the helper to help the individual in need: First, this was indicated by a higher percentage of first fixations on the character in need ($M = 37.3\%$) than on the other character ($M = 29.6\%$) in the anticipatory-looking phase, $F(1, 68) = 4.10$, $p = .047$. This effect did not differ between age groups, given that the Age × ROI interaction was not significant, $F(2, 68) = 0.77$, $p > .250$. Second, the infants looked longer at the outcome of the picture stories in which the helper passed the ball to the character that was not in need ($M = 2.06$), compared with the outcome of the picture stories in which the character was able to acquire the ball on its own ($M = 1.90$), $F(1, 68) = 6.24$, $p = .015$. Again, this effect did not differ between age groups, given that the Age × Condition interaction was not significant, $F(2, 68) = 0.57$, $p > .250$. The similarity across age groups was substantiated by the group means of both measures (Table 1). Descriptively, the largest effects among all age groups were found in 9- to 11-month-olds in both the anticipatory-looking and violation-of-expectation phases.

In the control condition, collapsing across age groups, we found no significant differences in the percentage of anticipatory looks (character in need: $M = 21.1\%$; character not in need: $M = 25.4\%$), $p > .250$. Furthermore, fixation durations in the violation-of-expectation phase revealed no main effect of condition (expected condition: $M = 2.24$ s; unexpected condition: $M = 2.23$ s), $F(1, 63) = 0.00$, $p > .250$, and no interaction between age and condition, $F(2, 62) = 0.39$, $p > .250$.

The infants' helping behavior increased with age (9–11 months: $M = 10.7\%$; 12–14 months: $M = 39.2\%$; 15–18 months: $M = 69.8\%$), $F(2, 68) = 21.16$, $p < .001$. However, their helping behavior was not related to their understanding of another individual's need: First, the percentage of objects handed over to the experimenter was not associated with a higher percentage of anticipatory looks made to the character in need rather than the other character ($r = .05$, $p > .250$). Second, no correlation was found between the infants' helping behavior and the differences in looking times between trials with an expected outcome and trials with an unexpected outcome ($r = .03$, $p > .250$).

Discussion

The findings showed that infants in our study understood the need in other individuals even before they started to act prosocially themselves. Furthermore, they expected

Table 1. Results for the Anticipatory-Looking and Violation-of-Expectation Phases

Phase and variable	Age group: 9–11 months	12–14 months	15–18 months
Anticipatory looking			
Trials with first look at the character in need (%)	39.3 (5.1)	37.0 (3.9)	36.0 (6.1)
Trials with first look at the character not in need (%)	26.2 (4.2)	35.7 (4.2)	26.3 (4.2)
Violation of expectation			
Looking time when the character in need received help (s)	1.77 (0.13)	1.91 (0.08)	2.00 (0.16)
Looking time when the character not in need received help (s)	2.03 (0.10)	2.06 (0.11)	2.10 (0.10)

Note: The table presents means with standard errors in parentheses.

that other people would act prosocially by orienting their behavior toward individuals in need.

Understanding the needs of other people is a necessary precondition for early helping behavior to be genuinely prosocial (Eisenberg et al., 2006; Hoffmann, 1981). In the present eye-tracking study, we demonstrated this capacity in young infants, controlling for common alternative interpretations of behavioral studies. In the critical condition, the infants saw two characters that both (a) could serve as potential partners for a social interaction and (b) did not complete a goal-directed action. Thus, the present results cannot be explained by the infants' expectancy that people engage socially or tend to complete an initiated action. There were two critical differences from earlier studies: (a) There were two potential recipients of help, but only one actually needed help to achieve a goal, and (b) gaze behavior, instead of behavioral measures, was used to infer the infants' situational understanding. Furthermore, our conclusion was based on converging evidence of two standard measures: First, when the helper engaged in the scene, the infants showed anticipatory looking toward the character in need; second, longer looking times indicated that the infants were surprised if the helper helped the other character instead. In addition, the null results of the control condition indicate that the infants did not prefer one scene to the other because of the configuration of elements of the scenes or the former familiarization phase (i.e., the shapes moving together harmonically or independently).

Certainly, the fact that understanding other individuals' needs was not related to the infants' prosocial behavior does not imply that there is no relation between understanding needs and helping people. In particular, as helping situations get more complex (e.g., Buttelmann, Carpenter, & Tomasello, 2009; Warneken & Tomasello, 2006), understanding other individuals' needs is the key to prosocial behavior. However, in these situations, the question is less about infants' ability to represent other people's needs than it is about their ability to identify other people's needs (e.g., accounting for specific obstacles or false beliefs). Furthermore, although the present results demonstrate that infants possess the critical and necessary cognitive prerequisite for early helping behavior to be prosocial, this does not imply that all socially responsive and prosocial behavior is motivated prosocially.

The fact that infants start to understand that other individuals have needs before they are responsive to these needs themselves raises intriguing questions about further developmental attainments that lead to the emergence of helping behavior in the second year. One key competence underlying early prosocial behavior might be a sense of oneself as an accountable and competent interaction partner in social encounters (Kärtner, 2015). This idea is also implied in theoretical accounts that emphasize toddlers' emerging motivation and competence to coordinate their own behavior with other individuals' behavior during mutual collaboration (Tomasello, Carpenter, Call, Behne, & Moll, 2005). Possibly, an early sense of one's own competences in situations affording help may benefit, first, from caregivers' scaffolding during infants' task engagement (Hammond & Carpendale, 2015; Köster, Cavalcante, de Carvalho, Resende, & Kärtner, in press), and, second, from important motor developments occurring around this age, providing infants with novel abilities to engage in their physical and social environment (Neisser, 1993).

Author Contributions

M. Köster and J. Kärtner designed the study and wrote the manuscript. M. Köster, X. Ohmer, and T. D. Nguyen designed the stimuli and conducted the study. M. Köster and X. Ohmer analyzed the data. J. Kärtner supervised the research.

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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

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