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Negativity bias in infants' expectations about agents' dispositions

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This study investigated 6- and 10-month-old infants' abilities to infer others' preferences based on social interactions using looking time and choice measures. Infants were randomly assigned to either a helping/neutral or hindering/neutral condition. Those in the helping/neutral condition were first familiarized with a helping event, in which an agent helped a circle climb a hill, and a neutral event, in which another agent followed the same path as the helping agent but had no interaction with the circle. During the test phase, the circle approached either the helper or the neutral agent. In the hindering/neutral condition, the infants were familiarized with a hindering event, in which an agent hindered the circle from reaching the top of the hill, and a neutral event, in which another agent followed the same path as the hindering agent but had no interaction with the circle. During the test phase, the circle approached either the hinderer or the neutral agent. For the looking-time measure, infants in the hindering/neutral condition looked reliably longer at the approach-hinderer than at the approach-neutral agent event, whereas those in the helping/neutral condition looked for equal amounts of time at both test events. These results suggest that the infants expected the circle to avoid the hinderer but did not expect it to approach the helper. In the choice task, infants chose the helper more often than the neutral agent and the neutral agent more often than the hinderer, suggesting an ability to generate their own preferences for a particular agent based on the valence of helping and hindering actions. This research demonstrates infants' sensitivity to the moral valence of agents' social interactions, which may serve as a foundation for advanced socio-moral reasoning.

Statement of contribution

What is already known on this subject?

- Research on infants' ability in social evaluation has established that even preverbal infants can distinguish between positive and negative social interactions.
- Infants as young as 6 months of age can distinguish between helping and hindering actions and can generate their own preference towards helpful agents.

What does this study add?

- The present study sheds light on infants' ability to infer a third-party's preference, which is a more challenging task for the infants than generating their own preference.
- Specifically, 6- and 10-month-old infants could infer others' preference for the neutral agent over the hinderer.
- Such results demonstrate infants' sensitivity to the moral valence of agents' social interactions and provide an evidence of negativity bias in social evaluation.

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In everyday life, humans interpret and evaluate others' behaviours. For instance, if you see person A opening the door for someone carrying a stack of books, you will likely have a positive impression of person A. Conversely, if you witness person B slamming the door on someone trying to enter a building with heavy grocery bags, you are likely to have a negative view of B's behaviour. Whether you are an observer or an active participant in an act, you constantly make such judgements about everyday social interactions.

How does this ability develop? Developmental psychologists have discovered that infants can distinguish between positive and negative social interactions. For example, 12-month-olds can attribute different values to helping/caressing and hindering/hitting actions (Premack & Premack, 1997). Infants can also infer or predict an agent's disposition towards another agent, based on whether a previous social interaction between the agents was positive or negative (Fawcett & Liszkowski, 2012; Hamlin, Wynn, & Bloom, 2007; Kuhlmeier, Wynn, & Bloom, 2003; Lee, Yun, Kim, & Song, 2015). For example, in Hamlin *et al.* (2007), 10-month-olds were familiarized with helping and hindering events. When a circle attempted to climb a hill, either a helper (a triangle or a square) bumped the climber up to the top of the hill (a helping event) or a hinderer (a triangle or a square) nudged the climber to the bottom of the hill (a hindering event). During the test phase, the infants looked longer when the climber approached the hinderer rather than the helper, thereby suggesting that they expected the circle to approach the helper and were surprised when it approached the hinderer. Thus, the 10-month-olds could infer that the climber preferred the helper to the hinderer. Infants demonstrate even earlier sensitivity to the differences between helping and hindering actions in tasks that measure their own preferences for particular agents. In a study by Hamlin *et al.* (2007) and Hamlin, Wynn, and Bloom (2010), infants of 3 months and older demonstrated their preference for agents who engaged in helping behaviours over those who engaged in hindering behaviours. Taken together, these previous findings suggest that infants can distinguish between the two opposing-valenced actions and can generate their own preferences or infer others' preference for helpful agents.

A remaining question is whether infants simply discriminate between prosocial and antisocial behaviours or place values along a continuum, attributing positive values to helping actions, negative values to hindering actions, and neutral values to actions that are neither helpful nor hindering. Hamlin *et al.* (2007) made an initial attempt to investigate this question. In one experiment, 10- and 6-month-old infants were familiarized with helping (or hindering) and neutral events in turn. In the neutral event, a circle simply sat at the foot of a hill, while another agent moved uphill or downhill, following the same path as the helper or hinderer but having no interaction with the circle. Both the 6- and 10-month-old infants chose the helper over the neutral agent and the neutral agent over the hinderer. However, the infants looked at the test events approximately equally whether the circle approached the helper/hinderer or the neutral agent. Hamlin *et al.* (2007) concluded that the infants developed their own positive evaluations of the helper and negative evaluations of the hinderer. However, the infants did not demonstrate an understanding that the circle would have different dispositions towards the helper or hinderer and the neutral agent.

We suggest two possible explanations for this response. First, the infants may not have considered the valence of helping and hindering actions when inferring a third-party's preference for other agents, in contrast to the way they responded when generating their own preferences. Second, the neutral scenes were different in the helpful and hindering comparisons; for this reason, they may not have been fully neutral. For instance, in the neutral scene paired with the helping event, the moving agent could have been perceived as indirectly helping the agent at the foot of the hill by demonstrating how to climb the hill;

this may have led to a positive interpretation. Conversely, in the neutral scene paired with the hindering event, the moving agent could have been perceived as teasing or attacking the other agent, leading to a negative interpretation. These positive or negative undertones in the neutral scenes may have created some difficulty for the infants when they sought to infer the circle's attitude towards the other agents.

The current experiment modified the stimuli used by Hamlin *et al.* (2007) to reduce the potentially valenced nuances in the neutral scene. There was a slight change in the position of the circle: It was situated in the middle of the upper part of the scene, instead of at the foot of the hill, while another agent moved up and down the hill. This made it very clear that the agents were not interacting. We expected this modification to reduce the ambiguity of the scene, making it easier for the infants to use the valence of the helping or hindering action to infer the circle's preference for the helper or hinderer. As a result, the infants' looking times would be different in the test events. However, if the infants still did not use the valence of action to inferring others' behaviours, the infants' looking times to the two test events would be approximately equal, whether the circle approached the helper/hinderer or the neutral agent. When indicating their own preferences, we expected the infants to show similar patterns to those demonstrated in Hamlin *et al.* (2007), in which the infants chose the helper over the neutral agent and the neutral agent over the hinderer.

Method

Participants

Twenty-eight 6-month-old (13 female, mean age = 6 months and 7 days, age range = 5 months and 5 days to 6 months and 29 days) and 29 10-month-old (14 female, mean age = 10 months and 7 days, age range = 9 months and 8 days to 11 months and 7 days) healthy full-term infants participated in the study. Another 22 infants were tested but excluded from the analyses because of crying (9), fussiness (7), drowsiness (1), observation difficulty (1), parental interference (1), having a looking time in the test trial over 2.5 standard deviations from the mean of the condition (2), and reaching the maximum looking time in all the trials (1).[1] Half of the infants in each age group were randomly assigned to the *helping/neutral* condition, and the other half to the *hindering/neutral* condition.

The infants were recruited through advertisements in online parenting communities. They received a book in return for their participation, and their parents were offered reimbursement for their transportation expenses. Each infant's parent gave written informed consent; the study protocol was approved by the local Institutional Review Board.

Stimuli and procedure

Looking-time task

The stimuli depicted in Figures 1–4 are available at https://www.youtube.com/channel/UCtXfSGl3_GgKa0wqoJ3bFMw?view_as=subscriber. During the experiment, each infant

[1] *The criteria for excluding the infants whose looking times (1) were over 2.5 standard deviations from the mean for the condition in a test trial and (2) reached the maximum looking time in all the trials were adopted from the previous research (e.g., Saffran, 2001; Song & Baillargeon, 2008; Song, Baillargeon, & Fisher, 2005) and were pre-specified as a part of standard analysis choices in the laboratory.*

sat on his or her parent's lap and was centred in front of a 22-inch LCD monitor (LG L226WTQ). The infant's head was approximately 62 cm from the monitor. The parents were instructed to close their eyes and remain silent throughout the experiment.

The experiment used computer-animated videos similar to those used in Kuhlmeier *et al.* (2003). Computer-generated stimuli were chosen over live displays because 12-month-olds (Fawcett & Liszkowski, 2012; Kuhlmeier *et al.*, 2003) and even 6-month-olds (Lee & Song, 2014) seem to infer agents' dispositions when watching computer-generated scenes. The videos showed the movements of three agents with eyes and a nose – a red circle, a yellow square, and a green triangle – on two blue hills against a white background. The infants received four familiarization trials, one pretest-display trial, and four test trials.

At the beginning of the familiarization trials for the helping or hindering events, a red circle was located in the middle of the upper part of the screen (see Figures 1 and 2). The circle came down to the bottom of the first hill, began to climb, and reached the top of that hill. It then attempted to reach the top of the second hill but slid back to the bottom. On its third attempt to climb the second hill, the circle was either pushed up by a helper that appeared at the bottom of the first hill, or pushed down by a hinderer that appeared at the top of the second hill. When the event ended, the helper and hinderer exited the screen where they had entered. Then, the circle became stationary at the top of the second hill (in the case of the helping event) or at the foot of the first hill (in the case of the hindering event). In the neutral event, the circle simply remained in the middle of the upper part of the screen, while another agent moved uphill or downhill, following the same path as the helper or hinderer but without interacting with the circle. Each familiarization video was 10 s long; it was repeated until each trial ended. The infants in the helping/neutral condition watched alternating helping and neutral events, while infants in the hindering/neutral condition watched alternating hindering and neutral events.

After the familiarization trials, the infants in both conditions took part in a static pretest-display trial (see Figure 3). There were no hills in this scene; only the three agents were present. The circle was centred at the bottom of the screen, and the square and the triangle were located in either the upper left- or upper right-hand corners of the screen.

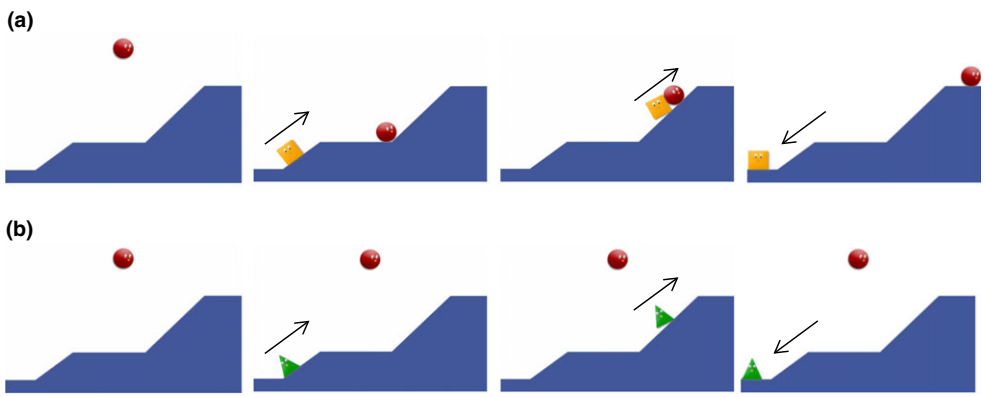

Figure 1. Selected frames from the familiarization videos in the helping/neutral condition: (a) In a helping event, the agent (a square) helps a circle climb the hill; (b) in a neutral event, another agent (a triangle) follows the same path as the helper in the helping action but has no interaction with the circle.

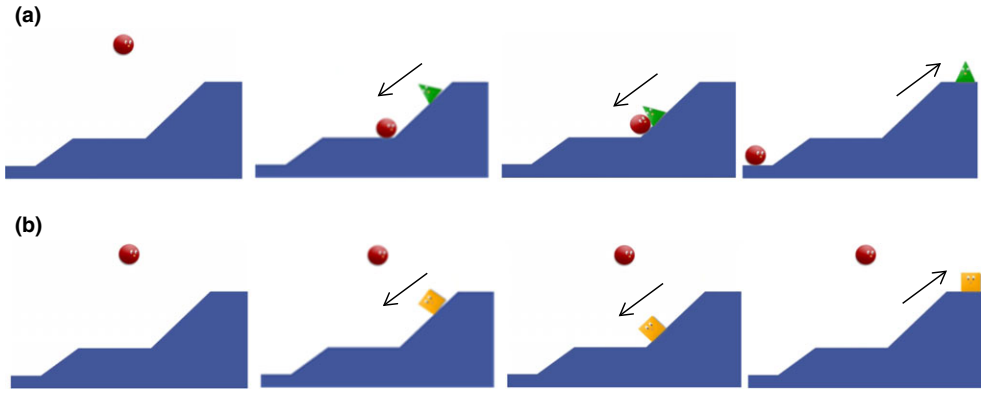

Figure 2. Selected frames from the familiarization videos in the hindering/neutral condition: (a) In a hindering event, the agent (a triangle) prevents a circle from climbing the hill; (b) in a neutral event, another agent (a square) follows the same path as the hinderer in the hindering action but has no interaction with the circle.

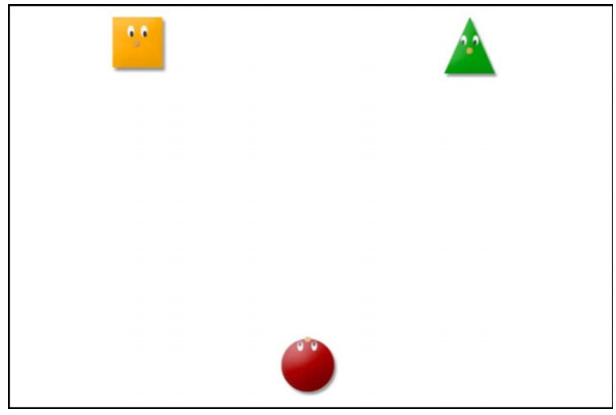

Figure 3. An example of the pretest-display trial.

Finally, the infants participated in test trials. In the helping/neutral condition, for the first 2.5 s, the circle either approached the agent that had helped it climb the hill (approach-helper event) or the agent that had never interacted with it, merely following the same path as the helper (approach-neutral agent event). This was followed by a 3-s pause. The approach-helper and approach-hinderer events were presented in alternate trials in the two pairs of test trials. In the hindering/neutral condition, the infants watched the approach-hinderer and approach-neutral agent events in alternate trials. The videos were repeated until each trial had ended.

The infants' looking behaviour was recorded by two observers, who sat on either side of the monitor and viewed the infants through peepholes in cloth-covered frames. Whenever an infant looked at the monitor, the observers pressed a button connected to a computer. The observers recorded the infants' looking times from the moment the video began. The looking times recorded by the primary observer were used to determine the length of the trial. In the familiarization phase, each trial ended when the infant looked away for two consecutive seconds after having looked for at

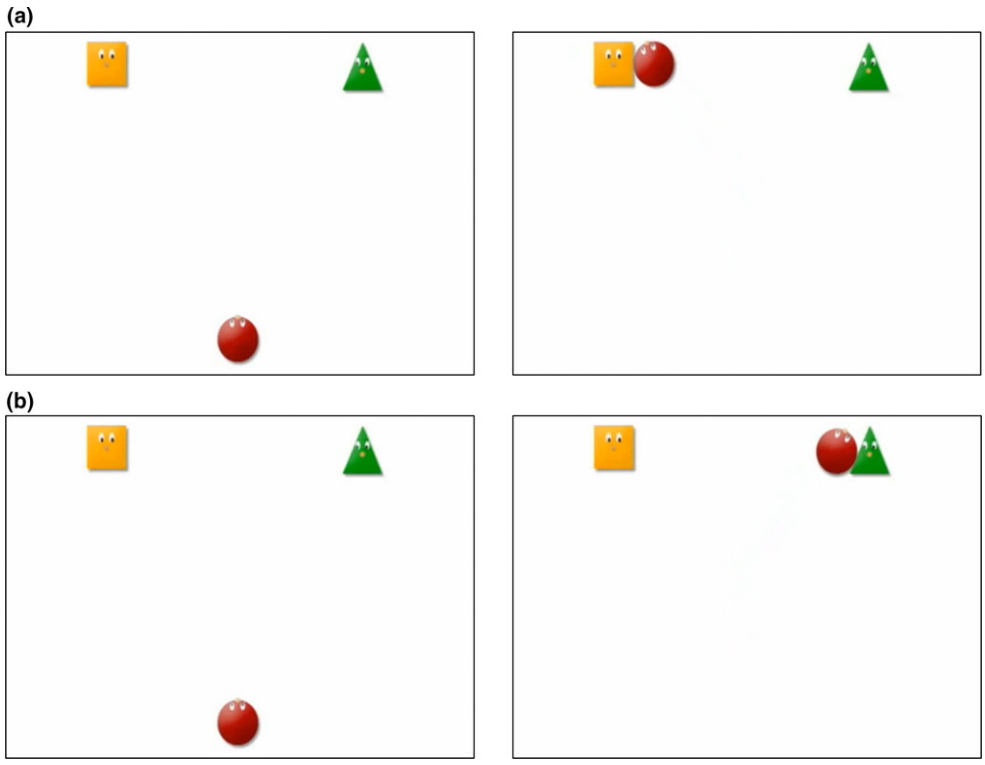

Figure 4. Scenes from the test video: The circle approaches either (a) the square or (b) the triangle. The square/triangle may be the helper/neutral or the hinderer/neutral agent, depending on the condition.

least 10 cumulative seconds, or when he or she looked for 60 cumulative seconds. The pretest-display trial ended when the infant looked away for two consecutive seconds after having looked for at least three cumulative seconds, or when he or she looked for 60 cumulative seconds. In the test phase, each trial ended when the infant looked away for two consecutive seconds after having looked for at least three cumulative seconds, or when he or she looked for 50 cumulative seconds. The observers' agreement was measured for 55 of 57 infants and averaged 91% per trial per infant.

The following were counterbalanced: whether the helping/hindering or neutral event was presented first during the familiarization phase, the identities of the helper/hinderer and the neutral agent, whether helper/hinderer or the neutral agent was on the left in the pretest-display and test trials, and whether the approach-helper/hinderer or the approach-neutral agent event was presented first during the test.

Choice task

The infants participated in a choice task after completing the looking-time task and having a short break. The parents and infants resumed the same positions they were in during the looking-time task; however, this time, they faced the experimenter instead of the computer monitor. The parents were instructed to remain silent and not to interfere with the infants during the experiment. The infants were presented with two agents (a square

and a triangle), which were placed 25.5 cm apart on a white piece of foam board, within reach of the infants. They were encouraged to choose between the two. The agent that the infant touched first was coded as his or her choice. The positions of the two characters were the same as those in the pretest-display and test trials of the looking-time task.

Results

Looking-time task

The preliminary analyses showed no significant interaction involving age, gender, order of familiarization events, identities (square or triangle) of the helper/hinderer and neutral agent, order of the test events, or the agents' positions in the pretest-display and test trials: all Fs(1, 53) < 0.37, ps > .54. Therefore, in subsequent analyses, the data were collapsed across these factors.

The infants' looking times during the familiarization trials were averaged and analysed using a one-way analysis of variance (ANOVA) with the condition (helping/neutral or hindering/neutral) as a between-subjects factor. The main effect of the condition was not significant, $F(1, 55) < 1$, suggesting that the infants in the helping/neutral condition (M = 33.84, SD = 11.55) and those in the hindering/neutral condition (M = 34.88, SD = 13.97) tended to look for the same amount of time during the familiarization trials.

The infants' looking times during the pretest-display trial were analysed as described above. The main effect of the condition was not significant, $F(1, 55) = 3.11$, $p > .08$, suggesting that the infants in the helping/neutral condition (M = 11.30, SD = 6.62) and those in the hindering/neutral condition (M = 16.53, SD = 14.29) tended to look about equally during the pretest-display trial.

The infants' looking times during the test trials were averaged and analysed by means of a 2 × 2 ANOVA with the test event (approach-valenced [helping or hindering] agent or approach-neutral agent) as a within-subject factor and the condition (helping/neutral or hindering/neutral) as a between-subjects factor. The main effects of the test event, $F(1, 55) = 1.41$, $p > .24$, and the condition, $F(1, 55) < 1$, were not significant. However, the interaction between the test event and the condition was significant: $F(1, 55) = 8.32$, $p = .006$, $\eta_p^2 = .13$, 95% confidence interval or CI = 16.39, 21.42. Paired-sample t tests within each condition were conducted. In the hindering/neutral condition, infants looked reliably longer at the approach-hinderer event (M = 21.43, SD = 10.16) than at the approach-neutral agent event (M = 15.24, SD = 10.54), $t(28) = 3.04$, $p = .005$, $d = 0.56$, 95% CI = 2.01, 10.35, whereas those in the helping/neutral condition did not look reliably longer at the approach-helper event (M = 20.71, SD = 11.83) than at the approach-neutral agent event (M = 18.13, SD = 11.76), $t(27) = 1.14$, $p > .26$ (Figure 5). Non-parametric Wilcoxon rank-sum tests confirmed the results of the hindering/neutral condition ($W = 94$, $p = .008$) and the helping/neutral condition ($W = 144.5$, $p = .28$).

Despite no significant age effect, we conducted further separate analyses for each of the two age groups to determine whether the patterns reported above remained evident when only the younger infants were analysed. In the analysis of data related to 6-month-olds, the main effects of the test event and condition were not significant, Fs(1, 26) < 1.59, ps > .21. However, the interaction between the test event and the condition was significant: $F(1, 26) = 4.81$, $p < .05$, $\eta_p^2 = .16$, 95% CI = 14.99, 21.27. Paired-sample t tests revealed that 6-month-olds significantly looked longer at the approach-hinderer event (M = 19.13, SD = 8.96) than at the approach-neutral agent event (M = 13.25, SD = 7.80), $t(13) = 2.47$, $p = .028$, $d = 0.66$, 95% CI = 0.73, 11.02;

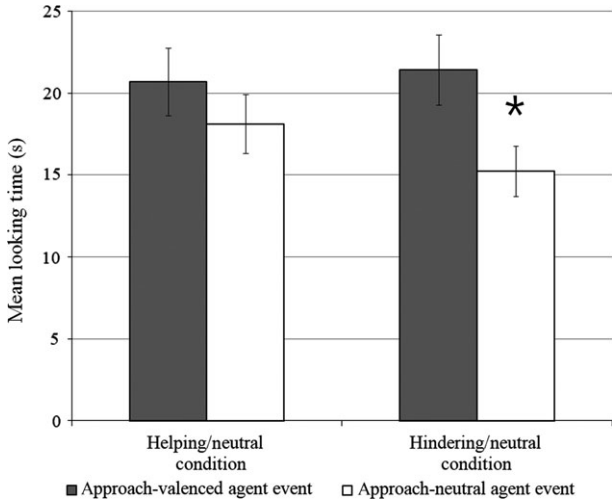

Figure 5. Infants' mean looking times for the test events. Error bars represent standard errors, and an asterisk denotes a significant difference between the two events within a condition ($p < .05$ or better).

there was no reliable difference in the looking times for the approach-helper ($M = 21.73$, $SD = 11.45$) and approach-neutral agent events ($M = 18.32$, $SD = 10.70$), $t(13) = 0.98$, $p > .34$. These results resemble those for the 10-month-olds. In the analysis of data related only to 10-month-olds, the main effects of the test event, $F(1, 27) = 1.12$, $p = .30$, and the condition, $F(1, 27) < 1$, were not significant, but the interaction between the test event and the condition was marginally significant: $F(1, 27) = 3.34$, $p = .079$, $\eta_p^2 = .11$, 95% CI = 15.51, 23.70. The 10-month-olds looked marginally significantly longer at the approach-hinderer event ($M = 23.57$, $SD = 11.02$) than at the approach-neutral agent event ($M = 17.09$, $SD = 12.56$), $t(14) = 1.94$, $p = .072$, $d = 0.50$, 95% CI = −0.67, 13.62; there was no significant difference in the looking times for the approach-helper ($M = 19.69$, $SD = 12.53$) and approach-neutral agent events ($M = 17.95$, $SD = 13.14$), $t(13) = 0.58$, $p > .57$.

Therefore, the 6- and 10-month-olds showed an almost identical pattern: Infants in the hindering/neutral condition expected the circle to approach the neutral agent rather than the hinderer, whereas those in the helping/neutral condition had no expectation regarding which agent the circle would approach.

Choice task

We analysed the data from 45 infants who made a choice within 90 s after the two agents were presented. The infants in the helping/neutral condition chose the helper significantly more often than the neutral agent (15 of 21; binomial probability test, one-tailed $p = .039$, 95% CI = 0.52, 0.91), whereas those in the hindering/neutral condition chose the neutral agent significantly more often than the hinderer (17 of 24; binomial probability test, one-tailed $p = .032$, 95% CI = 0.53, 0.89), replicating the results of Hamlin *et al.* (2007; Figure 6). The interaction was confirmed by a non-parametric Fisher's exact test (two-tailed $p = .007$), which means that the infants' responses to the neutral agent were reliably different according to the conditions.

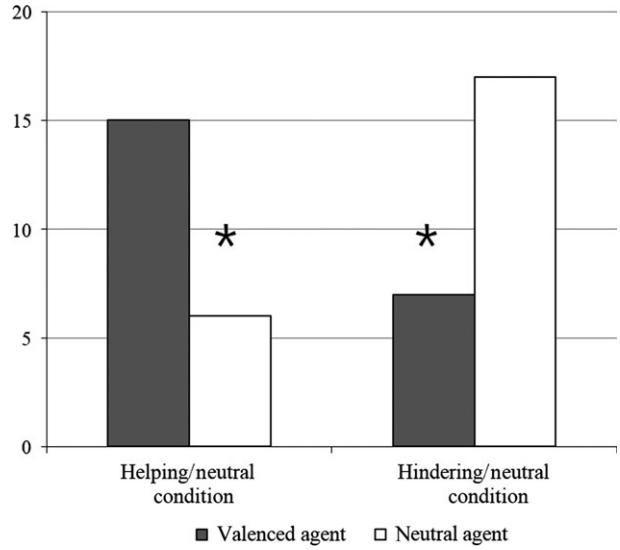

Figure 6. Number of infants choosing each agent. An asterisk denotes a significant difference ($p < .05$ or better).

Regardless of age, the infants tended to choose the more positive agent: the helper in the helping/neutral condition (6 of 10 10-month-olds and 9 of 11 6-month-olds) and the neutral agent in the hindering/neutral condition (8 of 11 10-month-olds and 9 of 13 6-month-olds). The data on the frequency of more and less positive agent choices were collapsed across the helping/neutral and hindering/neutral conditions; Fisher's exact test conducted on the combined data confirmed that there was no significant effect of age on infants' preferences for the more positive agent (Fisher's exact test, two-tailed $p > .74$).

Relationship between the choice and the looking-time task results

We conducted further analyses to determine whether the infants' performance in the choice task – that is, whether or not they correctly chose the relatively more positive agent – was related to their performance in the looking-time task. The infants' looking times during the test trials were analysed using a 2 × 2 × 2 ANOVA with choice task performance (correct vs. incorrect choosers) and the condition (helping/neutral or hindering/neutral) as between-subjects factors and the test event (approach-valenced or approach-neutral agent) as a within-subject factor. The main effect of the choice task performance and its interaction with the test event and condition were not significant – all Fs$(1, 41) < 2.90$, ps $> .09$, suggesting that the choice task performance had no significant influence on the looking-time task results.

However, some *post-hoc* analyses provide a hint about the relationship between generating one's own preferences and inferring another agent's preference. In the helping/neutral condition, the correct choosers looked at the approach-helper ($M = 19.29$, $SD = 13.36$) and approach-neutral agent ($M = 18.11$, $SD = 11.80$) events for an approximately equal amount of time, $F(1, 30) < 1$, whereas the incorrect choosers looked reliably longer at the approach-helper event ($M = 26.17$, $SD = 9.05$) than at the approach-neutral agent event ($M = 15.37$, $SD = 7.63$), $F(1, 11) = 6.91$, $p = .02$, $d = 3.59$,

95% CI = 7.64, 13.96. In other words, infants who preferred the neutral character to the helper in the choice task also expected the agent to prefer the neutral character to the helper. However, in the hindering/neutral condition, both the correct and incorrect choosers tended to look longer at the approach-hinderer event (correct choosers: $M = 20.16, SD = 9.70$; incorrect choosers: $M = 20.37, SD = 10.65$) than at the approach-neutral agent event (correct choosers: $M = 16.27$, $SD = 12.02$; incorrect choosers: $M = 13.91$, $SD = 9.68$), although the tendency did not reach statistical significance in separate analyses of the two groups, correct choosers: $F(1, 30) = 2.01, p > .10$; incorrect choosers: $F(1, 11) = 2.47$, $p > .10$. Further research is therefore needed to verify the relationship between the choice and looking-time tasks results.

Discussion

The present research investigated the sensitivity of 6- and 10-month-old infants to the valence of agents' helping and hindering actions. Specifically, we asked whether the infants understood that others could distinguish the helper or hinderer from the neutral agent, just as the infants themselves were able to do.

In the choice task, the infants preferred the helper over the neutral agent and the neutral agent over the hinderer. These results add to the evidence on the development of infants' ability to form first-party preferences based on the valence of actions. In Hamlin *et al.* (2010), 3-month-olds looked longer at the neutral agent than at the hinderer, but they did not look reliably longer at the helper than the neutral agent, suggesting that 3-month-olds have some negativity bias, a phenomenon in which negative stimuli evoke stronger reactions than positive ones and have a greater impact on the individual (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001; Cacioppo & Gardner, 1999). The present research, along with previous research (Buon *et al.*, 2014; Hamlin *et al.*, 2007), shows that negativity bias affecting first-party preferences disappears by 6 months of age: Infants 6 months and older distinguish both positive and negative events from a neutral event, when generating their own preference for an agent.

The results from the looking-time task provided the first evidence that infants consider the negative nature of certain morally relevant actions when inferring others' preferences for a particular agent. The infants looked longer at the approach-hinderer event than at the approach-neutral agent event,[2] suggesting that they expected the circle, like themselves, to avoid the hinderer and approach the neutral agent. Thus, when the neutral condition clearly demonstrated that there was no interaction between the agents, the infants were able to infer the circle's preference for the neutral agent over the hinderer.

[2] *The direction of looking times has been inconsistent in previous studies that used a task similar to ours. Kuhlmeier* et al. *(2003) found that infants looked longer at the event in which the helper (who enabled the achievement of the goal) rather than the hinderer (who impeded the goal) was approached. By contrast, other research (Hamlin* et al., *2007; Lee* et al., *2015), along with the present results, has revealed the opposite pattern in looking times. For example, in Hamlin* et al. *(2007), the infants looked longer at an event in which the agent approached the hinderer than at an event in which the agent approached the helper. We speculate that some slight but nontrivial changes in the stimuli (e.g., adding humanlike features, such as eyes and a nose) in some previous studies (Hamlin* et al., *2007; Lee* et al., *2015) and our present research may have facilitated the infants' understanding of the events, leading to the different results obtained by Kuhlmeier* et al. *(2003). However, the point that should be highlighted is that infants have shown significantly different looking times for helping and hindering actions across different studies (consistent within studies). Infants' looking patterns, regardless of their direction, demonstrate their ability to discriminate between helping and hindering actions. In fact, in Kuhlmeier* et al. *(2003), no predictions were made about the direction of the infants' preferences, and in line with our argument, their findings were interpreted as showing that infants expected the third-party to approach the helper and avoid the hinderer (see also Hamlin* et al., *2007, for a similar interpretation).*

Importantly, the infants in the current research were observers who were not linked to the agents in the scenes or involved in their interactions. Understanding third-party relationships is fundamental to interpreting societal structures; it may guide our learning about complex social interactions and help us analyse and predict abstract states, such as others' affiliation patterns (Liberman, Kinzler, & Woodward, 2014). Our results demonstrate the infants' sophisticated ability to evaluate the value of actions based on the interactions among third parties.

With regard to the looking-time task, additional factors may have led to the differences between the current findings and those of Hamlin *et al.* (2007). We used familiarization instead of habituation. The method of exposing infants, before the test, to a predetermined number of trials (familiarization) instead of presenting as many trials as necessary (up to a particular limit) until the infants reduce their looking by a pre-specified amount (habituation), has been widely used (e.g., Needham & Baillargeon, 1997; Phillips, Wellman, & Spelke, 2002; Xu & Carey, 1996), especially when infants are presumed to have a secure understanding of the phenomenon being examined. Moreover, in the current study, the videos were repeated until the end of each trial so that the infants could be exposed to the event several times; however, in Hamlin *et al.* (2007), the event was displayed only once in each trial. These differences, in addition to the reduced ambiguity in the neutral action, could have facilitated the infants' performance in the looking-time task. Further research can examine which of these changes are needed to reveal that young infants possess the ability to sensitively distinguish between social events which have not been previously proven.

One remaining question is whether the infants might not only have inferred the climber's inclination to avoid the hinderer but also have expected many different kinds of negative relationship to exist between the climber and the hinderer. For instance, infants might have inferred not only the climber's negative disposition towards the hinderer but also the hinderer's negative disposition towards the climber. Future research could examine this possibility, using test events in which the helper/hinderer approaches the climber (as in Kuhlmeier *et al.*, 2003), rather than the climber approaching the helper/hinderer (as in the current experiments.)

Meanwhile, the current results have revealed no evidence that infants consult the valence of helping actions when inferring an agent's disposition. The infants looked about equally whether the circle approached the helper or the neutral agent. Their lack of sensitivity to the valence of helping actions in the looking-time task may have been driven by negativity bias. Researchers have uncovered negativity biases in various developmental domains, such as making social references (Vaish, Grossmann, & Woodward, 2008), engaging in selective learning (Hamlin & Wynn, 2012), using emotional information (Mumme & Fernald, 2003), and attributing agency (Hamlin & Baron, 2014). Moral judgement is one of the most prominent fields in which negativity bias has been demonstrated (Rozin & Royzman, 2001). The infants' heightened sensitivity to negative social information may have adaptive value, as it helps them to avoid threatening situations and ensures their survival (Buon *et al.*, 2014). Such negativity bias may have helped the infants to more easily distinguish the hinderer from the neutral agent from a third-party's perspective than to distinguish between the helper and the neutral agent – a more challenging task for them.

However, there are alternative explanations of the apparent negativity bias in the looking-time task results. First, the final scenes of the test events in the helping/neutral condition could have been more difficult for the infants to distinguish than those in the hindering/neutral condition. While the circle remained near the top of the screen in the

neutral events in both conditions, its location at the end of the test event differed between the helping (the top of the second hill) and hindering (the bottom of the first hill) events. The infants may have perceived the two final scenes in the helping/neutral condition as perceptually more similar than those in the hindering/neutral condition.

Second, the neutral event that was paired with the helping event may have been confusing. While the neutral agent who followed the helper's path entered the scene from the lower left-hand side of the scene, the circle was looking to the right. The circle could have been viewed as being unable to see the movement of the neutral agent, which may have made the event look strange. Such processing demands in the helping/neutral condition may have led the infants to fail in inferring the circle's disposition.

Third, the infants may have inferred some positive relationship in the neutral event that was paired with the helping event. The neutral agent could have appeared to be showing the circle how to climb the hill, suggesting a positive interaction between the agents. Such positive nuances in the neutral event may have hindered the infants from readily distinguishing between the helping and neutral events. This possibility could be investigated by modifying the stimuli – for example, by removing the circle during neutral events.

Despite features that could have made the hindering and neutral events easier to distinguish from each other than the helping and neutral events, some of current findings cannot be explained solely through these possibilities because no negativity bias was revealed in the choice task. The discrepancy in the results between the choice and looking-time tasks is likely due to the nature of each task. In the looking-time task, the infants needed to infer the third-party's preference for another agent, whereas in the choice task, the infants needed only to reveal their own preference for an agent (Geraci & Surian, 2011). Reasoning about another's disposition may be more cognitively demanding than generating one's own preference because it requires a representation of the internal state of the agent. Thus, the infants may have revealed negativity biases only when inferring others' dispositions (in the looking-time task), despite being able to attribute a positive value to the helper and a negative value to the hinderer (when presenting their own preferences in the choice task).

Some predictions can be made if the development of infants' social evaluation abilities starts with generating personal preferences, followed by the ability to make third-party inferences. For instance, infants older than those in the current study might expect the circle not only to avoid the hinderer but also to approach the helper, because they are better at making inferences from a third-party perspective. As infants initially show some negativity bias (Hamlin *et al.*, 2010) and then a response pattern that distinguishes both positive and negative events from neutral ones (Hamlin *et al.*, 2007) in the choice task, older infants, unlike infants of 10 months or younger, might show sensitivity to both the positivity and the negativity of actions in a looking-time task. Another prediction would be that the negativity bias demonstrated in third-party evaluations only appears in infants who make correct choices both in the helper/neutral (i.e., grasping the helper) and hinderer/neutral (i.e., grasping the neutral agent) conditions. However, this possibility remains an open question since the current study used a between-subjects design.

Infants' sensitivity to the valence of other types of moral actions is also worthy of further investigation. For example, while there is a large body of research on infants' understanding of fairness (Geraci & Surian, 2011; Schmidt & Sommerville, 2011; Sloane, Baillargeon, & Premack, 2012; Sommerville, Schmidt, Yun, & Burns, 2013), studies have simply compared two opposing conditions: fair and unfair distributions. More sophisticated evaluative abilities could be assessed by examining fairness along a continuum (from

the least fair, through neutral, to the fairest distributions of resources). This expanded research will provide evidence about whether infants are attracted to a fair distributor or avoid an unfair distributor (Meristo & Surian, 2013).

The present research adds to a growing body of work on social evaluation in the first year of life. Our findings shed light on infants' ability to infer a third-party agent's preferences on the basis of its previous interactions with others and go beyond infants' ability to express their own attitudes towards social agents. Such a refined social evaluation system is essential for learning social skills and adapting to a community as a social member. Further study is required to examine early evidence of socio-moral reasoning in relation to other types of goals and social contexts.

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