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PAPER

Three-month-olds show a negativity bias in their social evaluations

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Abstract

Previous research has shown that 6-month-olds evaluate others on the basis of their social behaviors – they are attracted to prosocial individuals, and avoid antisocial individuals (Hamlin, Wynn & Bloom, 2007). The current studies investigate these capacities prior to 6 months of age. Results from two experiments indicate that even 3-month-old infants evaluate others based on their social behavior towards third parties, and that negative social information is developmentally privileged.

Introduction

Infants prefer some individuals over others. From early in life, infants prefer to look at those who are physically attractive (e.g. Langlois, Roggman, Casey, Ritter, Reiser-Danner & Jenkins, 1987; Samuels & Ewy, 1985; Slater, von der Schulenberg, Brown, Badenoch, Butterworth, Parsons & Samuels, 1998), those who wear positive emotional expressions (e.g. D'Entrement & Muir, 1999; Grossman, Striano & Freiderici, 2007; Haviland & Lelwicka, 1987) and those who make direct eye contact (Farroni, Csibra, Simion & Johnson, 2002). In addition, several recent studies suggest that infants prefer to gaze at those who are members of familiar groups (e.g. Bar-Haim, Ziv, Lamy & Hodes, 2006; Kelly, Quinn, Slater, Lee, Gibson, Smith, Ge & Pascalis, 2005; Kinzler, Dupoux & Spelke, 2007, Quinn, Yahr, Kuhn, Slater & Pascalis, 2002). Importantly, studies using more interactive methods (e.g. Kinzler *et al*., 2007; Langlois, Roggman & Reiser-Danner, 1990) have shown that the individuals that young infants prefer to *look at* are the same individuals that older infants are likely to *positively interact with*, providing essential support for the claim that studies of infants' visual attention tap their true social preferences.

The studies above suggest that infants distinguish and prefer particular others based on physical characteristics and familiar group status. Can infants form impressions of individuals based on how those individuals treat others? Indeed, distinguishing those who behave prosocially versus antisocially, and avoiding the antisocial, is a skill essential to survival in the social world. There is prior evidence that infants assign valence to social acts: 12-month-olds associate positive actions with other positive actions (caressing with helping) and negative actions with other negative actions (hitting with hindering) (Premack & Premack, 1998), 12-month-olds associate helping actions with attractive faces and hindering actions with unattractive faces (Taylor-Partridge, Griffin, Rosen, Langlois & Principe, 2006), and 12-month-olds expect a character to approach someone who had previously helped it, as opposed to one that previously hindered it (Kuhlmeier, Wynn & Bloom, 2003, under review). Additionally, recent research suggests that in addition to valencing social acts, infants evaluate the actors involved in such acts: 6- and 10-month-old infants approach those who have helped another achieve a goal, and avoid those who have prevented another from achieving a goal (Hamlin Wynn & Bloom, 2007). Importantly, infants in these studies were passive observers who were neither helped nor hindered themselves, and had no previous experience with the individuals involved. This suggests that the simple observation of social behavior is sufficient to motivate social evaluation.

Hamlin *et al*. (2007) found no age differences in the social preferences of 6- and 10- month-old infants: both ages (a) preferred prosocial (helping) individuals to antisocial (hindering) individuals, (b) preferred prosocial to 'neutral' individuals (who neither helped nor hindered), and (c) preferred neutral to antisocial individuals. The studies reported here investigate the early emergence and developmental progression of these social preferences, by studying 3-month-old infants.

There are reasons to expect that 3-month-olds may be capable of social evaluation. Three-month-olds are reliable social partners: Their smiles are selectively social (Wolff, 1963), they hold eye contact well (Haith, Bergman & Moore, 1977), and they recognize and distinguish between different individuals (Barrera & Maurer, 1981; Bartrip,

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Morton & de Schonen, 2001). Additionally, they have some expectations of how others should interact with them (e.g. becoming distressed when a social partner presents a 'still face'; Tronick, Als, Adamson, Wise & Brazelton, 1978). Moreover, recent evidence suggests that they can, in some cases, identify the goal of an agent's action (Luo, 2009; Sommerville, Woodward & Needham, 2005).

On the other hand, 3-month-olds' reasoning about goal-oriented behavior may be more fragile than that of older infants. Indeed, some evidence suggests that in order to reason about others' goals, 3-month-olds require personal experience with the specific goal behavior involved (e.g. Sommerville *et al.*, 2005; but see Luo, 2009). Indeed, 3-month-olds are behaviorally far more limited than infants even a few months older, and lack experience performing many goal-directed actions (for example, moving along a particular trajectory in space, or obtaining a desired object). As such, they may fail to identify the goals of others' behaviors, and thus should fail to appreciate the valence of those who block versus facilitate these behaviors.

The choice method used in Hamlin *et al.* (2007) is not appropriate for use with 3-month-olds, who cannot reliably reach for objects (McDonnell, 1975). As reviewed above, studies with very young infants typically employ 'Preferential Looking' measures in which greater visual attention to one of two simultaneously presented stimuli indicates preference. Of course, there are many reasons why infants may prefer to look at one visual stimulus over another; doing so does not necessarily indicate greater positive affect towards the 'preferred' individual. While there is evidence that in some situations, visual preferences correspond with social preferences (Kinzler *et al.*, 2007; Langlois *et al.*, 1990), it is important to examine this issue in the current paradigm. Thus, a preliminary experiment examined whether older infants looked longer (indicating visual preference) at an individual they later chose to interact with (indicating social preference).

Preliminary experiment: Do infants look longer at those they choose to interact with?

To ensure that, for our stimuli and procedures, infants' preferential looking accords with preferential reaching measures, we examined the looking behavior of the 6-month-olds tested in Hamlin *et al.* (2007), many of whom took an extended time to reach for one character over the other. Thus, there was a time period in which infants were *looking* at the characters prior to their reach. We had videotapes of 11 of the 12 6-month-old infants tested (one was lost due to equipment failure). A blind coder measured infants' looking to each of the two characters prior to the infant's reach. Infants' looking accorded with their reaching: All 11 infants ultimately *reached* to the Helper, and 10 of the 11 infants ($p < .01$) *looked longer* to the Helper than the Hinderer prior to making their Reaching choice. (Infants' mean looking time preference for the Helper over the Hinderer was 2.8 s, $t(10) = 4.289$, $p < .03$.)

As we found agreement in preferential looking and preferential reaching methods, we adopted a Preferential Looking method to examine 3-month-olds' social evaluations. In Experiment 1, infants were shown a character that tried but failed to move toward the top of a steep hill, and was alternately helped (pushed up the hill) or hindered (pushed down the hill) in its goal (as in Hamlin *et al.*, 2007; Kuhlmeier *et al.*, 2003, under review). Following habituation, infants' visual preference for the Helper versus the Hinderer was measured. In order to control for the possibility that infants' preferences are not specifically social in nature, another group of 3-month-olds saw a physical control in which all social information was removed from the climbing character: it had no eyes and displayed no self-propelled motion, but was alternately pushed up and down the hill.

Experiment 1: Do 3-month-olds prefer prosocial to antisocial actors?

Subjects

Subjects were 24 3-month-old infants (11 girls; mean age 3 months, 14 days; range 3;3–4;3). Eight additional infants were excluded due to fussiness, and eight due to procedural error. Subjects in all experiments were healthy full-term infants. They were randomly assigned to a Social Condition containing Helping and Hindering events, or to an Inanimate Control Condition containing Pushing-Up and Pushing-Down events, as described below.

Stimuli and procedures

The habituation stimuli and general testing situation were as in Hamlin *et al.* (2007; events are viewable at http://www.yale.edu/infantlab/socialevaluation); all stimuli were presented live. Infants sat in an infant seat or on their parents' lap before a table with a curtain at the far end (165 cm from the infant) that could be lowered to occlude a display stage (122 cm wide, 66 cm high). The stage had a white background with a green 'hill' protruding 10 cm (43 cm vertical rise), with a 'plateau' one-third of the way up. Characters were wooden blocks 9 cm × 9 cm. The object pushed up or down the hill was a red circle with (Social condition) or without (Inanimate Control Condition) prominent 'googly eyes'; the other two characters were a blue square and a yellow triangle with 'googly eyes'; their Pusher-Upper/Pusher-Downer status was counterbalanced across infants. Stimuli are shown in Figure 1.

Habituation phase

Social condition. During habituation trials, infants saw a 'Climber' (a red circle with eyes) try but fail to reach the

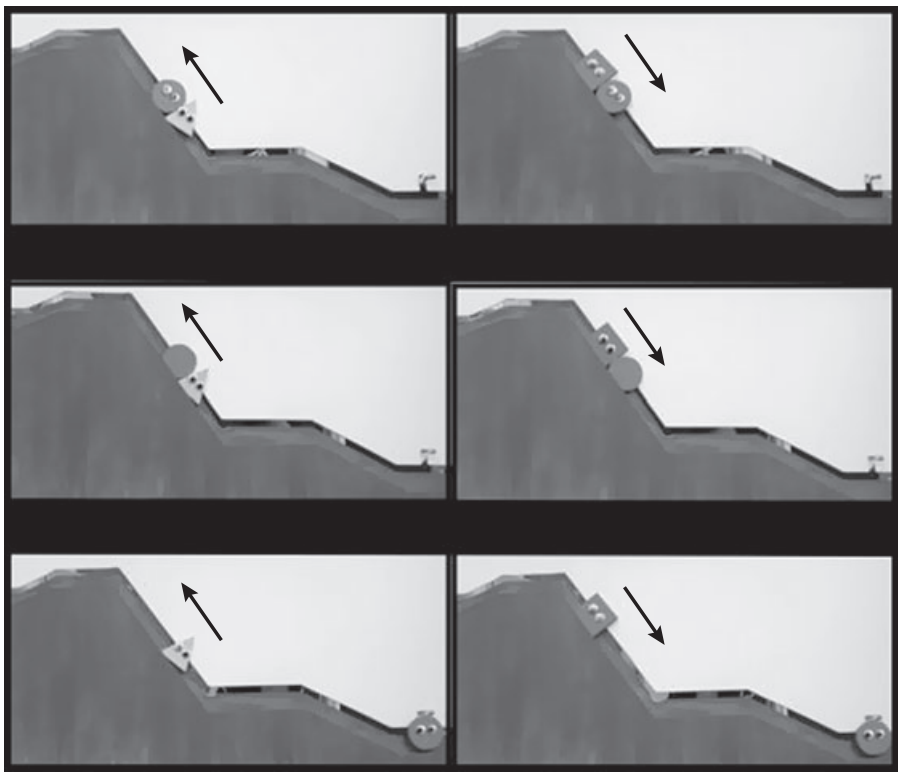

Figure 1 *Stimuli presented to the infants during habituation events. Row 1 represents the Helping and Hindering events of Experiment 1. Row 2 represents the Pushing-Up and Pushing-Down events of Experiment 1. Row 3 represents the Neutral events paired with Helping and Hindering events, used in Experiment 2.*

top of a hill. On each trial, the curtain occluder was raised to reveal the Climber resting at the bottom of the hill, at the right edge of the display. The Climber then moved up and to the left to the middle of the plateau, 'danced' for 2 s, then twice attempted but failed to reach the top, sliding partway down the steep slope each time. During a third attempt, it was bumped up to the top by a 'Helper' (Helping Pusher-Upper event), or bumped down to the bottom by a 'Hinderer' (Hindering Pusher-Downer event).

For all trials, after the Climber was pushed to its final position, the pushing character exited off-stage. Duration of each habituation event was 11 s. A coder blind to the characters' identities coded infants' looking to the display from the time the Helper/Hinderer exited the stage until the end of the trial, reached when (a) the infant looked away continuously for 2 s, or (b) 30 s elapsed. Infants saw Helping and Hindering habituation events in alternating sequence until a pre-set habituation criterion had been met: either the summed looking times on three consecutive trials after the first three were less than half the summed looking on the first three trials, or 14 trials had elapsed.

Inanimate control condition. In these events, a red circular inanimate object – which lacked eyes, and underwent no self-generated motion – replaced the Climber. During Pushing-Up events, the Pusher-Upper smoothly pushed the circle from the bottom of the hill to the top; during Pushing-Down events, the Pusher-Downer smoothly pushed the circle from the top of the hill to the bottom. Looking times were recorded as in the Social condition.

Test phase

Following habituation, infants' preference for the Helper/Hinderer or Pusher-Upper/Pusher-Downer was measured via their Preferential Looking. Parents were instructed to close their eyes, and an experimenter blind to the identities of the characters held them up approximately 50 cm from the infant's face. Infants' looking to the two characters was measured for a 30 s period starting when the infant first looked toward either character. A blind coder subsequently coded from videotape the amount of time each infant spent looking to each character. A second independent coder recoded a random 30% of subjects; their judgments were highly correlated, $r = .98$.

The color and shape of Helper and Hinderer (or Pusher-Upper and Pusher-Downer), order of habituation events, and location of characters during test were counterbalanced across subjects for this and the following experiment.

Results

For this and the following experiment, preliminary ANOVAs revealed no effects of sex, order of habituation

events, or character location on infants' looking times; subsequent analyses exclude these variables. An ANOVA on infants' looking times to the two Characters (Pusher-Upper vs. Pusher-Downer) with Condition (Social vs. Inanimate Control) and Character Features (Pusher-Upper = blue square vs. yellow triangle) as between-subject factors revealed a significant interaction between Condition and Character ($F(1, 22) = 4.543$, $p < .05$), with no other significant interactions or main effects. Planned contrasts indicated that infants in the Social condition looked more to the Helpful Pusher-Upper than the Hindering Pusher-Downer (mean looking to Helper = 13.12 s (standard error = 2.21), to Hinderer = 6.22 s (1.39); $t(11) = 2.213$, $p < .05$), but infants in the Inanimate Control condition had no preference (mean looking to Pusher-Upper = 7.89 s (standard error = 1.98), to Pusher-Downer = 10.93 s (2.16); $t(11) = -.807$, $p = .44$). This result was present in infants' individual patterns of response: ten of 12 infants in the Social condition preferred the Helper (binomial test, $p < .05$), but only five of 12 infants in the Inanimate Control condition preferred the Pusher-Upper (binomial test, $p > .99$). The non-parametric interaction is significant by a Fisher's Exact Test (one-tailed $p < .05$).

Discussion

In sum, infants preferred a character that helped the Climber up the hill over one that pushed the Climber down, but did not prefer a character that pushed an inanimate object up the hill over one that pushed it down. Three-month-olds' preference for Helpers over Hinderers appears to reflect a specifically *social* evaluation and not, e.g. a perceptual preference for 'uphill-goers' over 'downhill-goers'.

It is worth emphasizing that our control study cannot distinguish *which* aspect of social information is required for infants to make social evaluations, as we intentionally removed all social information from our control condition: the pushed object neither had eyes nor displayed any goal-directed behavior. The question of exactly which social aspects of an individual inspire infants to evaluate others' actions toward them as pro- and anti-social is a topic for future research.

Based on the results of Experiment 1, it is unclear whether infants were evaluating the characters based on the positive nature of the helping event, the negative nature of the hindering event, or both. A more specific question is whether infants this young will show more sensitivity to an antisocial character than to a prosocial one. This would accord with a general 'negativity bias' in which negative information is preferentially attended to, weighted, and remembered in adults' evaluation of social others and situations (Abelson & Kanouse, 1966; Aloise, 1993; Kanouse & Hanson, 1972; Knobe, 2003). There is much evidence that this bias is present in young children and older infants (Leslie, Knobe & Cohen, 2006; see Vaish, Grossmann & Woodward, 2008, for a review of the developmental literature). For example, infants engaging in 'social referencing' tasks are specifically sensitive to information signaling danger (e.g. Hornik, Risenhoover & Gunnar, 1987; Mumme & Fernald, 2003), and young children tend to preferentially discuss and remember negative events from their daily lives (e.g. Dunn, Bretherton & Munn, 1987; Miller & Sperry, 1988).

Due to the theorized adaptive value of biasing negative social information (Cacioppo, Gardner & Berntson, 1997; Vaish *et al.*, 2008), it would be telling to find evidence for a negativity bias in very young infants. Interestingly, there are a few studies (reviewed by Vaish *et al.*, 2008) that may point to a *positivity* bias in infants prior to 6 months, who have been shown to distinguish positive from neutral, but not neutral from negative, facial expressions (Farroni, Menon, Rigato & Johnson, 2007; LaBarbera, Izard, Vietze & Parisi, 1976). Thus, it is an open question whether our young subjects should bias either positive or negative information in their evaluations.

Hamlin *et al.* (2007) addressed this question with 6- and 10-month-olds by presenting infants with conditions in which infants chose *either* between a Helper and a Neutral character, *or* between a Neutral character and a Hinderer. Infants showed no evidence of either a negativity or positivity bias; they equally preferred helpers to neutral individuals and neutral individuals to hinderers (performing at virtually ceiling levels in both conditions). But a forced-choice paradigm is not ideally designed to reveal distinctions in relative strength of preference (in this case, if infants preferred neutral to negative *more strongly* than they preferred positive to neutral, or vice versa), and may have masked any asymmetrical processing of positive and negative information. In contrast, the preferential looking method used in the current studies provided a continuous measure of infants' relative preference for one character over the other, and may therefore be more sensitive to the existence of asymmetrical processing. In Experiment 2, we sought to determine whether young infants bias one valence of information over the other in their evaluations, by presenting infants with either a Helper and a Neutral character, or a Hinderer and a Neutral character, and measuring their preferential looking.

Experiment 2: Are 3-month-olds sensitive to prosocial agents, antisocial agents, or both?

Subjects were 24 3-month-olds (13 girls; mean age 3 months, 16 days; range 3;3–4;5). Six additional infants were excluded from the final sample due to a procedure error (two), or fussiness (four). Half the subjects were habituated to Helping and Neutral events, half saw Hindering and Neutral events. Helping and Hindering events were as in Experiment 1. On Neutral trials, the Climber 'danced' for 2 s at the bottom of the hill, then sat

motionless. In the Hindering/Neutral condition the Neutral character then entered from the upper left of the hill, 'bumped' down the hill twice, then moved back up the hill and exited (thus following the same path-of-motion as the Hinderer, but without interacting with the Climber). In the Helping/Neutral condition the Neutral character entered from the lower right, bypassed the Climber, and 'bumped' up the hill twice before moving downhill and exiting (thus following the same path-of-motion as the Helper, without interacting with the Climber). As in Experiment 1, infants' looking time on each trial was measured from the time the Neutral character exited the stage; habituation criteria were identical to Experiment 1. Following habituation, test trials proceeded as in Experiment 1.

A second coder independently coded infants' looking in test trials for a random 30% of subjects. The two observers' judgments were strongly correlated: $r = .99$.

Results and discussion

As shown in Figure 2b, an ANOVA on infants' looking times to the two Characters (More-Positive vs. More-Negative), with Condition (Helper/Neutral vs. Hinderer/Neutral) and Character Features (Neutral = blue square vs. Neutral = yellow triangle) as between-subjects factors, revealed a significant interaction between Condition and Character ($F(1, 22) = 4.743$, $p < .05$), with no other significant interactions or main effects. Planned contrasts revealed that in the Hinderer/Neutral condition infants gazed significantly longer at the more-positive character (mean looking to Neutral, 12.32 s (standard error = 2.33); mean looking to Hinderer, 2.86 s (.62), $t(11) = 3.774$, $p < .005$), but in the Helper/Neutral condition they looked equally to the two characters (mean looking to Helper, 8.17 s (standard error = 2.20); mean looking to Neutral, 8.64 s (1.98), $t(11) = -.125$, $p > .9$). Analyses of infants' individual patterns of response found that 10 of 12 infants in the Hinderer/Neutral condition preferred the more positive (Neutral) character (binomial test, $p < .05$), while only six of 12 infants in the Helper condition preferred the more positive (Helper) character (binomial test, $p > .99$); although the two conditions were not significantly different from each other (Fisher's Exact Test, $p = .19$).

These results suggest that at 3 months of age, a Hinderer is more aversive than a Neutral character, but a Helper is not more appealing than a Neutral character. These results align with data suggesting that negative information is privileged across a variety of social assessments for older infants, children, and adults (e.g. Abelson & Kanouse, 1966; Aloise, 1993; Kanouse & Hanson, 1972; Knobe, 2003; Leslie *et al*., 2006; Vaish *et al*., 2008).

General discussion

Our experiments show that infants as young as 3 months of age evaluate others on the basis of their social behavior toward third parties. Our findings also provide the first evidence, to our knowledge, of a negativity bias in infants this young: our subjects revealed an aversion to antisocial actors, but not an independent attraction to prosocial actors. This developmental pattern suggests that negative social information is developmentally privileged in influencing social preferences, and adds to the recent literature on the early development of the negativity bias (see Vaish *et al*., 2008).

As noted above, Vaish and colleagues review studies suggesting that very young infants may have a bias for *positive* information in the domain of face and voice perception. For example, very young infants distinguish positive facial expressions from neutral ones, but not neutral from negative ones (Farroni *et al*., 2007; LaBarbera *et al*., 1976; but see Montague & Walker-Andrews, 2001). It is difficult to compare our results with these findings as our stimuli are very different. They consist of novel painted blocks rather than human faces, and their valence-relevant aspects – the characters' behaviors – are

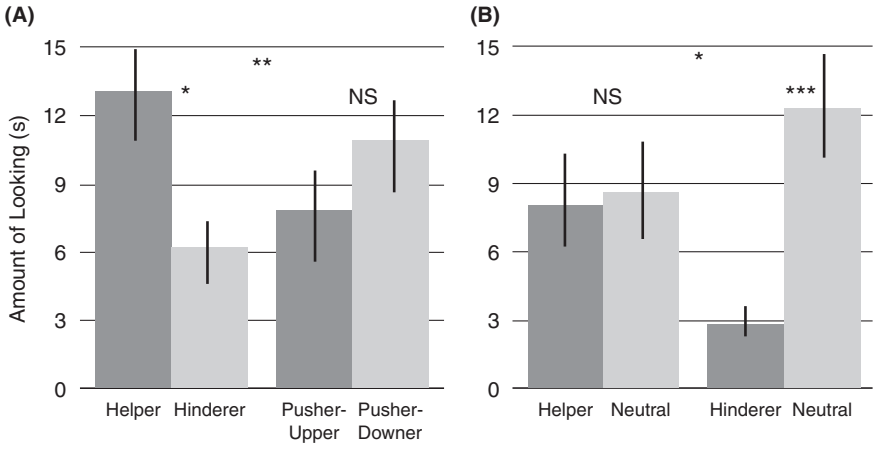

Figure 2 *Infants' looking (in seconds) to each character presented during preferential looking in Experiment 1 (Section A) and Experiment 2 (Section B).*

directed towards a third party rather than the infant, and moreover are absent during the looking measure. Nonetheless, these differences deserve some attention. We tentatively suggest that they may come from the special nature of 'neutral' facial expressions on the spectrum of positive to negative. Recent research suggests that adult subjects interpret neutral expressions as negative (e.g. Lee, Kang, Park, Kim & An, 2008). Infants may therefore have failed to distinguish neutral from negative expressions in previous studies because they did not view them as categorically different – they were all perceived as negative. The same argument could be made for voice perception. Regardless, the asymmetry we report here in young infants' processing of positive and negative social information parallels that found in older infants, children, and adults, suggesting developmental continuity in the priority of negative information.

Our subjects' ability to discriminate Helper from Hinderer in Experiment 1, and their preference for a Neutral character over the Hinderer in Experiment 2, suggests that they identified the Climber's goal to get uphill, and recognized that the Hinderer impeded this goal.[1] This result adds to the emerging literature suggesting that infants as young as 3 months of age can identify others' goals (Luo, 2009; Sommerville *et al.*, 2005), and supports the claim that infants do not require experience with a particular goal type to correctly interpret it in others (Luo, 2009). Additionally, we believe that infants' success in our task may have been aided by the relatively simple goal represented: infants needed to infer an intended *direction-of-motion*- or perhaps *location*-goal on the basis of the Climber's overall movement, and to recognize when that movement was impeded and by whom, and (possibly) when it was facilitated and by whom. Other studies examining goal understanding in this age group (Luo, 2009; Somerville *et al.*, 2005), in contrast, require that infants identify a particular goal out of two distinct possible goal objects, as well as track changing object locations over time, which may represent significant task demands for young infants that are not present in our stimuli.

Our subjects' discrimination of the Hinderer from the Neutral character in Experiment 2 suggests that they identified the Climber's goal to continue its trajectory up the hill, even though in this condition infants never saw the Climber reach the top. In this sense, then, our 3-month-olds were representing an unfulfilled goal; this is consistent with mounting evidence that infants in the first year of life readily identify unfulfilled goals (e.g. Hamlin, Hallinan & Woodward, 2008; Hamlin, Newman & Wynn, 2009; Marsh, Stavropoulos, Nienhuis & Legerstee, in press). However, assuming a goal of continued motion along an observed trajectory may not require the same inferential powers as inferring a goal in which the end-state differs qualitatively from the actions towards the goal (e.g. pulling apart a dumbbell-shaped toy, as in the classic experiment of Meltzoff, 1995). It may be that the ability to grasp a goal of continued motion in an established direction is a first step in an early developing ability to infer unseen or uncompleted goals.

In sum, we find that 3-month-olds have an aversion to antisocial actors – they recognize the negative valence of actions that impede the goals of others. This suggests that the capacity to evaluate others on the basis of their behavior is a fundamental aspect of social cognition.

[1] Infants may have also recognized that the Helper aided the Climber's goal. Their failure in Experiment 2 to prefer the Helper to the Neutral character suggests that they either failed to recognize the Helper's role in facilitating the Climber's goal, or that they recognized this, but did not generate a positive view of the Helper on this basis.

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