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BRIEF REPORT

Friends or Foes: Infants Use Shared Evaluations to Infer Others' Social Relationships

Zoe Liberman, Katherine D. Kinzler, and Amanda L. Woodward
University of Chicago

Predicting others' affiliative relationships is critical to social cognition, but there is little evidence of how this ability develops. We examined 9-month-old infants' inferences about 3rd-party affiliation based on shared and opposing evaluations. Infants expected 2 people who expressed shared evaluations to interact positively, whereas they expected 2 people who expressed opposing evaluations to interact negatively. A control condition revealed that infants' expectations could not be due to mere perceptual repetition. Thus, an abstract understanding that 3rd-party affiliation can be based on shared intentions has roots in the 1st year of life. These findings have implications for understanding humans' earliest representations of the social world.

Keywords: affiliation, social cognition, infancy

Because human societies involve complex social relationships and multiple levels of social organization, understanding affiliation patterns is a fundamental piece of social cognition. Adult humans and other primates readily reason about others' affiliative relationships (e.g., Cheney & Seyfarth, 2007; Cosmides, Tooby, & Kurzban, 2003; Kenny, Mohr, Bond, & Horn, 1996), but little is known about the developmental origins of this ability. Understanding affiliation is complicated, and information relevant for interpreting and predicting others' interactions is not always apparent through observable features such as perceptual similarity or physical proximity. Adults conceive of abstract similarities between people, such as shared attitudes, beliefs, and intentions, as indicating affiliative bonds (e.g., Byrne & Nelson, 1965). Infants also use intentions to understand other people's actions (e.g., Woodward, Sommerville, Gerson, Henderson, & Buresh, 2009), but it is unknown whether infants recruit such knowledge to reason about the interpersonal structure of the social world. In the current research, we investigate whether infants use intentions to form expectations about third-party affiliation, and specifically ask whether infants' social expectations recruit information about others' shared and opposing evaluations.

Infants show impressive selectivity in their own social affiliations: They prefer to interact with individuals who were previously nice (e.g., Hamlin & Wynn, 2011; Hamlin, Wynn, & Bloom, 2007), and individuals who share their preferences (Mahajan & Wynn, 2012) or native language (Kinzler, Dupoux, & Spelke, 2007). However, it is possible that these precocious social achievements are limited to situations that directly involve the infant, reflecting a desire to feel safe, which draws infants toward familiar or similar others. If infants' affiliative inferences were limited to first-person situations, they could nonetheless choose good social partners without analyzing and predicting other people's affiliation patterns.

Nevertheless, understanding third-party affiliation is fundamental to interpreting societal structure. An understanding of third-party relationships could functionally guide infants' learning about others and their predictions about complex social interactions. Past research reveals that infants have at least rudimentary expectations about third-person social interactions. Infants expect people to face their conversation partners and to talk to people rather than objects (Augusti, Melinder, & Gredebäck, 2010; Beier & Spelke, 2012; Molina, Van De Walle, Condry, & Spelke, 2004), and infants make predictions about others' patterns of approach and avoidance (Fawcett & Liszkowski, 2012; Johnson et al., 2010; Kuhlmeier, Wynn, & Bloom, 2003). However, although gaze and approach can signal affiliation, affiliation is in principle orthogonal to these constructs. Social relationships tie people together across great distances, and approach behaviors with directed gaze can result in negative as well as positive interactions. Importantly, abstract concepts—including shared attitudes, beliefs, and evaluations—can indicate third-party affiliation. Whether infants have abstract expectations about the nature of third-party affiliation remains an open question.

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Zoe Liberman, Katherine D. Kinzler, and Amanda L. Woodward, Department of Psychology, University of Chicago.

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Correspondence concerning this article should be addressed to Zoe Liberman, 5848 South University Avenue, Chicago, IL 60637. E-mail: zoeliberman@uchicago.edu

In the current research, we investigated the nature of infants' reasoning about third-party affiliation by testing whether infants recruit abstract information about others' shared or opposing intentional evaluations to make inferences about their social relationships. Information that two individuals have shared or opposing evaluations can provide evidence about whether they will affiliate. Indeed, infants and children choose to interact with others who share their preferences (e.g., Fawcett & Markson, 2010; Mahajan & Wynn, 2012), and shared evaluations are predictive of children's real-world friendships (e.g., Werner & Parmelee, 1979). However, reasoning about third-party evaluations may be challenging for infants because understanding shared evaluative states is inherently abstract: it requires attending to intentions over surface features of actions. To express shared evaluations, people must act on the same referent and provide the same evaluation. If two people manipulate the same referent but evaluate it differently, they do not have shared evaluations. Likewise, individuals who provide similar evaluations but act on different referents are not expressing shared evaluations. Thus, interpreting shared evaluations requires sophisticated reasoning beyond attending to surface-level properties.

In the current study, we investigated whether infants use information about others' intentions, as expressed by shared or opposing evaluations, to infer those individuals' subsequent affiliation. We depicted evaluations of food because food may provide particularly salient social information. Eating with friends and family is inherently social, food choices can indicate cultural conventions, and infants use others' food evaluations to inform their own affiliation choices (e.g., Fischler, 1988; Mahajan & Wynn, 2012; Miller, Rozin, & Fiske, 1998; Shutts, Kinzler, & DeJesus, 2013).

Infants viewed video familiarization events in which two adults displayed shared or opposing evaluations of foods. Infants then viewed test trials in which the adults interacted with one another positively and negatively. Because infants look longer at events that are inconsistent with their conceptual analysis of a situation (e.g., Hespos & Baillargeon, 2008), attention during the test trials served as evidence concerning infants' social inferences. Thus, if infants expect shared and opposing evaluations to be predictive of subsequent affiliation patterns, then infants' relative looking to positive and negative test trials should differ depending on their familiarization condition. We predicted that infants familiarized to two people expressing shared food evaluations would look relatively longer at test trials depicting negative social interactions, whereas infants familiarized to two people expressing opposing food evaluations would look relatively longer at test trials depicting positive interactions. To control for lower level perceptual features that could produce similar results, another group of infants was familiarized to perceptually similar events in terms of the vocalizations and valences of the opinions expressed. However, in control events, each actor acted on a different referent, meaning that actors did not express meaningful shared or opposing evaluations. Because the control condition did not depict information about shared intentional states, we did not predict that infants' patterns of looking to test trials would vary systematically. By comparing across conditions, we could test whether infants use information about shared and opposing evaluations to guide their inferences about social relationships, and, if so, whether these inferences depend on the intentional structure of the shared and opposing opinions or on surface-level similarities in the actors' behavior.

Method

Participants

Sixty-four 9-month-old infants (36 female; M_{age} = 9 months 1 day; age range = 8 months 10 days–9 months 24 days) participated. Six additional infants were excluded due to computer malfunction (one), low observer reliability (one),[1] parental interference (one), and distress (three). Participants were randomly assigned to either the experimental or control condition.

Procedure

During familiarization, infants watched a video repeat four times. Videos featured two adults. One at a time, each actor expressed one positive food evaluation (saying, "Ooh. I like that" in a high tone after eating) and one negative food evaluation (saying "Ew. I don't like that" in a low tone after eating). The first eater, the side of the table she sat on, the first bowl selected, and the valance of the first evaluation were counterbalanced between infants.

In the experimental condition, each actor ate from both bowls, and the actors expressed shared or opposing evaluations of the two foods. Half the infants saw *shared evaluations* events, during which the actors both expressed positive evaluations of the same food and negative evaluations of the other food (see Figure 1), and half saw *opposing evaluations* events, during which the actors expressed positive and negative evaluations of opposite foods.

In the control condition, each actor expressed both positive and negative evaluations; however, each actor ate twice from her own bowl. Thus, although these events were perceptually similar to experimental events in terms of the patterns of vocalizations and number of positive and negative evaluations depicted, the shared referential structure was disrupted because actors did not act on common referents. Half the infants saw *echoing* events (vocalizations matched shared evaluations) and half saw *alternating* events (vocalizations matched opposing evaluations) (see Figure 2).

Following familiarization, all infants viewed six alternating test trials. In *positive interaction* trials, the actors faced the infant and then turned toward each other, paused briefly, and smiled and waved while saying "Hi!" in a high-pitched voice. In *negative interaction* trials, the actors faced the infant and then turned toward each other and paused briefly before turning away from each other, crossing their arms and saying "Hmp" in a low-pitched voice (see Figure 3). Trials paused on a still screen, and infants' looking times were recorded to the still images; trials ended when the infant looked away for 2 consecutive seconds. The order of test trials was counterbalanced between infants.

Trained observers coded infants' attention online using jHab (Casstevens, 2007). Observers were unaware of the participant's condition. For reliability, a second observer coded each infant

[1] A priori criteria for inclusion was that coders had to agree on at least four of six test trials; one infant failed to meet this criterion.

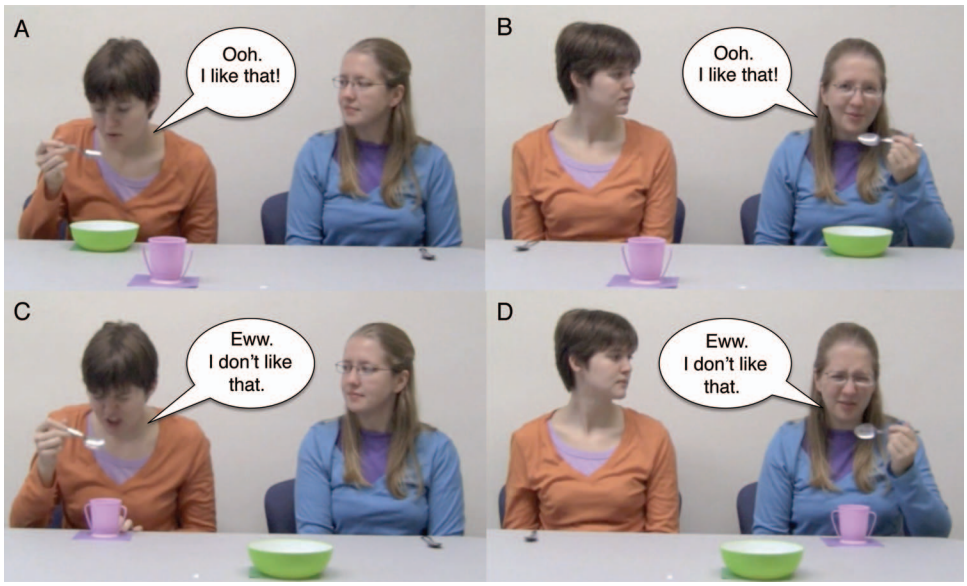

Figure 1. Shared evaluations event example. Both actors expressed positivity to the same food (Pictures A and B) and negativity toward the other food (Pictures C and D). Both individuals who appear here gave signed consent for their likenesses to be published in this article.

from video. To agree, coders had to judge that the same look away from the stimulus ended the trial; coders agreed on 92% of test trials.

Results

Preliminary analyses revealed no effects of sex, test order, speaker order, or evaluation order, so analyses collapsed across these factors. To evaluate attention during familiarization, a repeated measures analysis of variance (ANOVA) was conducted, with condition (experimental vs. control) and event (shared evaluations/echoing vs. opposing evaluations/alternating) as between-subjects factors and trial number (first, second, third, and fourth) as a within-subjects factor. There were no significant differences (all $ps > .2$), suggesting infants attended equivalently to familiarization events across conditions.

For test trials, a repeated measures ANOVA evaluating infants' looking times, with condition (experimental vs. control) and event (shared evaluations/echoing vs. opposing evaluations/alternating)

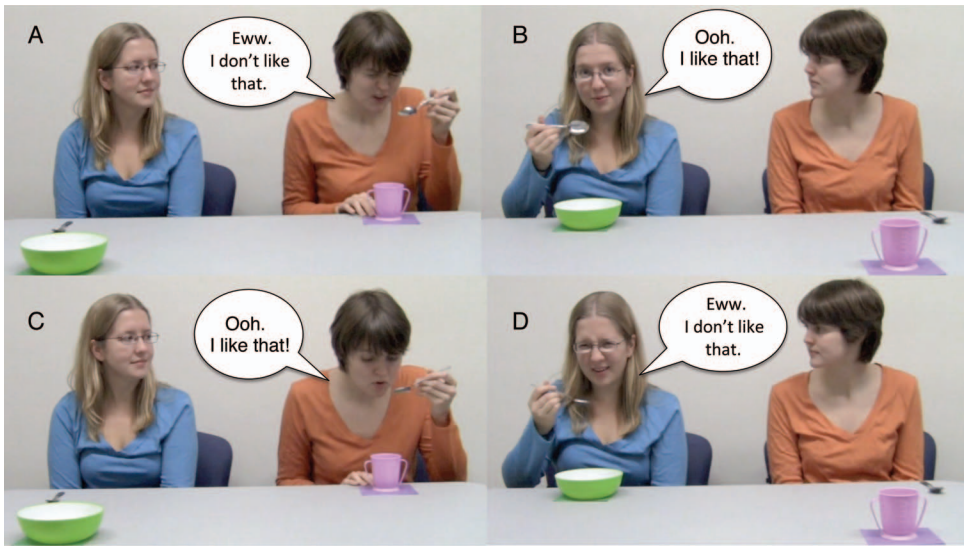

Figure 2. Alternating event example. Each actor expressed one evaluation of the food in her bowl (Pictures A and B) and then switched her opinion (Pictures C and D). The structure depicted is analogous to opposing evaluations. Both individuals who appear here gave signed consent for their likenesses to be published in this article.

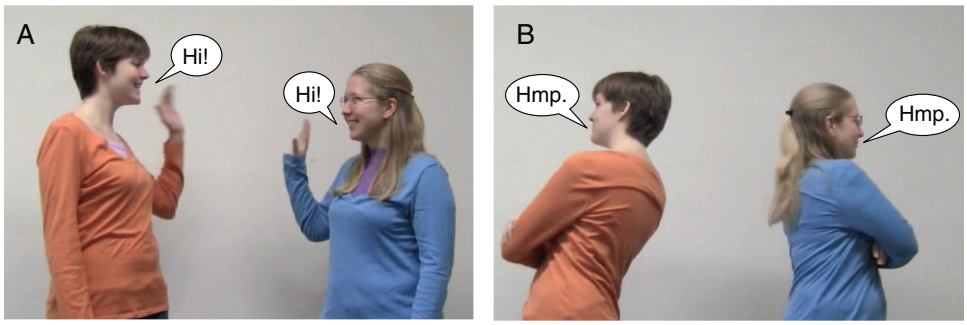

Figure 3. Test trials. Looking times were recorded to still frames from the end of each type of test trial. Positive interaction trials (A) alternated with negative interaction trials (B), with the first test trial counterbalanced between subjects.

as between-subjects factors and test pair (first, second, or third) and test type (positive vs. negative interaction) as within-subjects factors, revealed a significant main effect of test pair, $F(2, 59) = 12.56$, $p < .01$, $\eta_p^2 = .13$, reflecting decreasing attention; a significant effect of type, $F(1, 59) = 4.54$, $p < .05$, $\eta_p^2 = .02$, reflecting longer looking to positive ($M = 10.0$ s) than negative ($M = 8.8$ s) interactions; and a significant Type × Event interaction, $F(1, 60) = 5.63$, $p < .05$, $\eta_p^2 = .02$. Critically, the effect of type and the Type × Event interaction were qualified by a predicted three-way interaction between condition, event, and type, $F(1, 60) = 7.54$, $p < .01$,$\eta_p^2 = 0.29$. No other main effects or interactions reached significance ($ps > .15$).

To further investigate the predicted three-way interaction, and to determine whether information about shared and opposing evaluations influenced infants' attention to test trials differently than the perceptually similar control familiarization events, each condition (experimental vs. control) was analyzed separately.

Experimental Condition

For test trials, a repeated measures ANOVA evaluating infants' looking times, with event (shared evaluations vs. opposing evaluations) as a between-subjects factor and test pair (first, second, or third) and type (positive vs. negative interaction) as within-subjects factors, revealed a significant main effect of pair, $F(2 ,29) = 4.21$, $p < .05$, $\eta_p^2 = .13$, reflecting decreasing attention, and a significant interaction between event and test type, $F(1, 30) = 21.42$, $p < .01$, $\eta_p^2 = .42$. No other effects or interactions reached significance ($ps > .15$). Infants who saw shared evaluations events looked longer at negative ($M = 9.7$ s) than positive interactions ($M = 7.8$ s), $F(1, 15) = 5.48$, $p < .05$, $d = 0.60$, whereas infants who saw opposing evaluations events looked longer at positive ($M = 10.4$ s) than negative interactions ($M = 6.7$ s), $F(1, 15) = 17.78$, $p < .01$, $d = 0.92$ (see Figure 4). No other main effects or interactions were significant.

In order to confirm that the pattern of results was not due to looking patterns by a few infants but instead held across the sample, the results were also analyzed nonparametrically. The majority of infants who saw shared evaluations events looked longer at negative interactions ($n = 12$ of 16, binomial $p < .05$, one-tailed), whereas the majority of infants who saw opposing evaluations events looked longer at positive interactions ($n = 15$ of 16, binomial $p < .001$, one-tailed). These results are significantly different from one another (Fisher's exact test, $p < .001$, two-tailed) (see Table 1).

Control Condition

For test trials, a repeated measures ANOVA evaluating looking times, with event (echoing vs. alternating) as a between-subjects factor and test pair (first, second, or third) and type (positive vs. negative interaction) as within-subjects factors, revealed a significant main effect of pair, $F(2, 29) = 8.32$, $p < .01$, $\eta_p^2 = .31$, reflecting decreasing attention. No other main effects or interactions reached significance ($ps > .2$). Importantly, there was no significant interaction between test type and event, $F(1, 30) = 0.05$, $p > .8$, $\eta_p^2 = .001$, and no significant main effect of type, $F(1, 30) = 2.11$, $p > .2$, $\eta_p^2 = .07$ (see Figure 4).

Viewed nonparametrically, there were no significant differences in the number of infants who looked longer to either trial type ($n = 6$ of 16 and $n = 9$ of 16 looked longer at negative interactions after watching echoing and alternating events respectively, binomial $ps > .5$). These results are not significantly different from one another (Fisher's exact test, $p > .7$) (see Table 1).

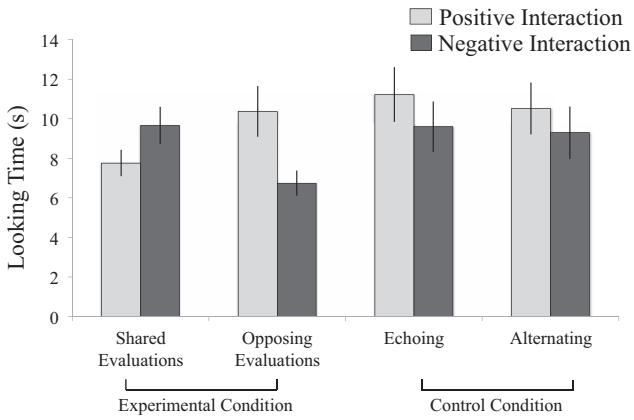

Figure 4. Looking times across conditions. This figure illustrates the average looking times to both types of test trial for infants in each condition, with error bars indicating the standard error of the average looking time.

Table 1
Number of Infants Exhibiting Each Looking Time Pattern During the Test Phase

Condition	Positive > Negative	Negative > Positive	Binomial *p* value
Experimental			
Shared evaluations	4	12	$p < .05$
Opposing evaluations	15	1	$p < .01$
Control			
Echoing	10	6	*ns*
Altemating	7	9	*ns*

Discussion

In the current study, we tested whether infants use information about others' shared and opposing evaluations to infer patterns of third-party affiliation and disengagement. Across conditions, all infants saw two adults affiliate with or disengage from one another. Infants' responses varied on the basis of whether the adults expressed shared or opposing evaluations. When the adults agreed, infants looked longer at subsequent disengagement. When the adults disagreed, infants looked longer at subsequent affiliation. Because infants look longer at events that are inconsistent with their conceptual analysis, these findings suggest that infants expected affiliation following agreement, and disengagement following disagreement. Critically, infants' responses were based on the intentional nature of the evaluations rather than surface features: In control conditions, which paralleled experimental conditions but lacked shared referents, infants did not respond systematically. These findings provide evidence that infants make inferences about others' patterns of affiliation on the basis of intentional evaluations.

Infants' early representations of third-party affiliation are notably abstract. The information in the experimental condition did not rely on physical similarity, distance, or approach–avoid behaviors. The same actors were present in the same locations in all conditions, and thus their evaluations, rather than their physical properties or movements, drove infants' responses. Moreover, infants' differential expectations about others' affiliation could not be based on mere valence matching between familiarization and test: All familiarization events contained the same number of positive and negative evaluations, though they were deployed differentially toward referents. Finally, it is unlikely that infants had prior experience with the precise events depicted here.

On one hand, it may seem surprising that infants in the control condition did not exhibit differential expectations about others' affiliation based on their echoing versus alternating statements. Although the actors did not express shared intentional evaluations, they engaged in vocalizations that either mimicked or alternated with each other. Mimicry increases liking in the first-person domain (e.g., Chartrand & Bargh, 1999; Over, Carpenter, Spears, & Gattis, 2013), so it was conceivable that mere echoing could signal affiliation. Nonetheless, in these studies, infants did not interpret echoing as a signal of affiliation. Perhaps mimicry must be intentionally meaningful to be interpreted as socially relevant: Imitating someone's evaluation or goal may provide more useful social information than imitating less intentional actions. Furthermore, infants may have responded to the fact that each actor judged the same referent in two opposing ways, thus rendering their evaluations incoherent. Future work could explore these possibilities.

The current findings highlight the need to investigate the factors that aid infants' understanding of others' affiliation more generally. One possibility is that infants' third-person understanding is initially built from first-person social preferences. Infants may use the same cues to determine both whom to like and whether others will affiliate. In first-person affiliation scenarios, infants and children attend to others' food and toy preferences, native language, race, gender, and age (Bar-Haim, Ziv, Lamy, & Hodes, 2006; Fawcett & Markson, 2010; Kinzler et al., 2007; Mahajan & Wynn, 2012; Quinn, Yahr, Kuhn, Slater, & Pascalis, 2002; Shutts, Kinzler, McKee, & Spelke, 2009). It is possible that all these factors also aid infants' reasoning about others' relationships. Nevertheless, shared perceptual features are not always predictive of affiliation patterns: As examples, parents and children, and males and females, can show high levels of affiliation despite physical dissimilarity. Therefore, reasoning about shared behaviors and deep similarities may prove more useful to understanding patterns of affiliation and conflict than attending to surface-level features. It is an open question whether first- and third-person reasoning about affiliation emerge in series or in parallel, and how they may inform one another.

This study also raises questions about infants' expectations about the range of behaviors that might be expected of affiliative partners. If infants are sensitive to the general features that define affiliative relationships, they may expect two adults with shared evaluations to speak the same language, help each other achieve goals, or belong to the same social group. If this is the case, infants may be able to reason about affiliative relationships that involve a network of individuals. Alternatively, infants' social reasoning may initially be limited to specific social dyads. In support of this idea, although infants track dominance hierarchies between pairs (e.g., A > B and B > C), they do not reliably make transitive inferences for relationships they have not seen (e.g., A > C) (Mascaro & Csibra, 2012). Pursuing these questions will be critical for fully evaluating the nature of infants' reasoning about affiliation as a conceptually rich and abstract aspect of social structure.

To conclude, these findings provide the first evidence that the roots of a critical aspect of social cognition, reasoning about third-party affiliation based on shared and opposing evaluations, can be traced to infancy. Before infants develop complex affiliation networks or have access to explicit information about social structure, they make inferences about third-party affiliation based on others' intentional evaluations. This finding opens new lines of inquiry regarding the nature and development of humans' earliest understanding of interpersonal social structure.

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