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Who knows what's good to eat? Infants fail to match the food preferences of antisocial others

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ABSTRACT

Humans gather most of their knowledge about the world, including objectively true facts and specific cultural norms, by observing and being taught by others. Some individuals are worthy teachers and objects of imitation, having knowledge of cultural practices and positive intentions to inform. Others are better ignored because they are ignorant, because they mean us harm, or simply because we do not wish to be "like them." This study examines whether 16-month-olds are sensitive to the pro- or antisocial behavior of a source that demonstrates preference for two novel foods. Infants took the emotional reactions displayed by novel and previously prosocial sources, but not antisocial sources, into account when deciding what to eat. These results suggest that others' social behavior influences infants' likelihood to match their preferences, illustrating the influence of social evaluation on social learning.

Most of what we know comes from others. By observing and interacting with others socially, we gain a wealth of information required for successful existence, from the language and cultural practices of our social group to the workings of a particular piece of complex machinery. Humans, even in infancy, appear uniquely adapted to using others as sources of information, through such mechanisms as the reproduction of novel behaviors (Bandura, 1977; Barr, Dowden, & Hayne, 1996; Meltzoff, 2007; Tomasello, 1999; Tomasello, Kruger, & Ratner, 1993), the use of emotional reactions to appraise unfamiliar objects and events (Campos & Stenberg, 1981; Feinman, 1982; Klinnert, Campos, Sorce, Emde, & Svejda, 1983), and sensitivity to directed pedagogical interactions (Csibra & Gergely, 2006; Gergely & Csibra, 2005, 2006). Using these and other social learning mechanisms, infants rapidly

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acquire information and skills that would be difficult or impossible to learn via first person trial-and-error.

Despite the powerful influence of social sources in human development, research over the past two decades suggests that children do not take in all the information a source provides. Instead, they selectively incorporate some pieces of information and ignore others. In imitative interactions early in the second year of life, infants do not simply reproduce every action a model performs but seemingly incorporate their own analysis of the intentional and causal structure of action into their imitative acts. For example, young toddlers fail to imitate behaviors marked as accidental (Carpenter, Akhtar, & Tomasello, 1998) and reproduce only those pieces of actions that are causally related to a model's overarching goal, leaving out unnecessary or subordinate components (Brugger, Lariviere, Mumme, & Bushnell, 2007; Carpenter, Call, & Tomasello, 2005; Gergely, Bekkering, & Király, 2002; Nielsen, 2006; but see Horner & Whiten, 2005; Lyons, Young, & Keil, 2007, for evidence of faithful imitation in children). Additionally, infants sometimes go "below the surface" of observed behaviors, effecting end-states of goal-directed actions that were never actually completed and therefore must have been inferred (Bellagamba & Tomasello, 1999; Johnson, Booth, & O'Hearn, 2001; Legerstee & Markova, 2008; Meltzoff, 1995). These results suggest privileged roles for the mental and causal structures driving a source's behavior, over the physical nature of the actions themselves, as infants gather information from social others.

In addition to selecting *what* to learn from others, it is also important to select from *whom* to learn. Some individuals have information useful to infants, whereas others may not (Feinman, 1982). There are a variety of non-mutually-exclusive dimensions on which one might discriminate the value of information from potential sources. Perhaps the most basic is accuracy: whether a source's information is objectively true or false. Infants in the second year are sensitive to others' knowledge states (Liszkowski, Carpenter, & Tomasello, 2008; Onishi & Baillargeon, 2005; Tomasello & Haberl, 2003), and can identify (and sometimes attempt to correct) false statements (e.g., when a speaker labels a cup a "dog;" Koenig & Echols, 2003; Pea, 1982). A growing body of research showing impressive selectivity in preschool children (Birch & Bloom, 2002; Birch, Vauthier, & Bloom, 2008; Corriveau & Harris, 2009a; Jaswal & Neely, 2007; Koenig & Harris, 2005; Rakoczy, Warneken, & Tomasello, 2009; Sabbagh & Baldwin, 2001) suggests that sensitivity to epistemic states plays a role in how infants use others as sources of new information. For example, 16-month-olds fail to learn new words from previously inaccurate labelers (Koenig & Woodward, 2010), 14-month-olds are less likely to follow the gaze of someone who was previously unreliable (e.g., who expressed excitement while looking into an empty container; Chow, Poulin-Dubois, & Lewis, 2008), and 14-month-olds tend not to imitate the novel actions of those who incompetently performed familiar acts (e.g., put shoes on their hands; Zmyj, Buttelmann, Carpenter, & Daum, 2010). These results suggest that even in infancy, children are sensitive to past accuracy and do not learn from inaccurate sources.

However, past accuracy is not always directly available in a learning situation. Therefore, it would be beneficial to be sensitive to a source's potential for accuracy, or, in other words, that source's general expertise (Henrich & Gil-White, 2001; Lutz & Keil, 2002). Expertise may be evident from one's confidence and/or familiarity with a situation. The more confidence or familiarity an individual displays, the more likely a learner should be to select that individual to learn from. In a novel toy situation, infants as young as 12 months selectively reference an experimenter known to be familiar with a laboratory rather than their mother (unfamiliar with the lab), presumably due to an assumption that the experimenter's familiarity makes her more knowledgeable (Stenberg, 2003, 2009; Walden & Kim, 2005).

Further, some sources should be selected over others due not to their objective accuracy or expertise, but because of the potential relevance of their information to the learner. Things like linguistic forms, ritual behaviors, and food and object use may differ widely across cultures and groups and therefore should only be acquired from sources who know the forms relevant to a particular learner. Determining who has culturally relevant information is not necessarily easy, but could be facilitated by selectively attending to sources who are familiar, similar to the learner, or known to be within the learner's social group. Infants' tendency to socially reference highly familiar individuals (like mothers) versus unfamiliar individuals (like researchers) is ambiguous. Some studies have found that infants show no preference for caregivers over experimenters (Devouche, 2004; Klinnert, Emde, Butterfield,

& Campos, 1986; McCabe & Uzgiris, 1983; Meltzoff & Moore, 1992), others show a preference for experimenters (Stenberg, 2003, 2009; Walden & Kim, 2005), and still others have shown a caregiver advantage (Zarbatany & Lamb, 1985). Despite this ambiguity, preschoolers do selectively learn from familiar over unfamiliar teachers (Corriveau & Harris, 2009b), infants selectively choose objects and foods provided by individuals who speak their native language (Kinzler, Corriveau, & Harris, 2011; Kinzler, Dupoux, & Spelke, 2007; Shutts, Kinzler, McKee, & Spelke, 2009), and 14–18-month-olds more closely imitate the actions of models that are nearer to them in age, even a week after the initial modeling (Ryalls, Gul, & Ryalls, 2000). Together, these results suggest that familiarity, similarity, and group membership play a role in infants' source selection and information retention.[1]

Also potentially relevant is whether a source is liked. Liking is often related to familiarity and similarity but can also exist independently. Selectivity for positively and/or negatively evaluated sources might serve a variety of inter-related functions. First, if a disliked source in turn dislikes the learner, or is an antisocial individual in general, he or she may mean the learner harm. If so, the source's information may be intentionally misleading and should be ignored (Mascaro & Sperber, 2009; Vanderbilt, Liu, & Heyman, 2011). Second, even if a disliked source's information is objectively true, a learner may still choose to ignore it to avoid "being like" or "affirming a shared state with" the source. Achieving a sense of shared likeness has been theorized to be a social function of social learning mechanisms, in particular imitation (Hobson & Lee, 1999; Lakin & Chartrand, 2003; Meltzoff & Moore, 1995; Nadel, Guérini, Pezé, & Rivet, 1999; Over & Carpenter, 2009; Over & Carpenter, 2012; Uzgiris, 1981). If so, individuals should avoid accepting information from those they have negatively evaluated. In one series of studies (Nielsen, 2006; Nielsen, Simcock, & Jenkins, 2008), infants in the second year of life more closely imitate the actions of available, "socially engaged" individuals than socially-unavailable, "aloof" individuals, potentially indicating a role for social evaluation in imitative learning. Shutts, Kinzler, et al. (2009) found that infants' tendency to match the food preferences of native over foreign language speakers was enhanced when the native language speaker displayed positive affect (presumably liked by the infants) and the foreign language speaker displayed negative affect (presumably disliked). These results suggest a role for liking/disliking in source selectivity in infancy; however, they do not provide a direct test of this hypothesis.

The present study directly examines the link between social evaluation and the tendency to gain and use information from social sources in infancy. Like Shutts, Kinzler, et al. (2009), we did this in the domain of food, asking whether infants' tendency to eat the foods a source likes over the foods the same source dislikes is influenced by the source's previous third-party prosocial or antisocial behavior. Sixteen-month-old infants observed a single puppet source taste two similar, novel foods; the source expressed liking for one food and disliking for the other. Infants were then given the opportunity to eat the foods themselves. We observed the extent to which infants matched the source's preference. Prior to the food demonstration phase, all infants watched the same puppet show, in which a puppet tried but failed to open a box containing a toy. The unsuccessful puppet was then helped in his goal to open the box by a second "prosocial" character and hindered in his goal by a third "antisocial" character. Thus, in the *Prosocial Source* condition, the source of food liking/disliking information had previously helped a third-party to obtain a desired object; in the *Antisocial Source* condition, the source had hindered the third-party. Finally, in a third, *Novel Source* condition, although infants began by watching a prosocial/antisocial puppet show, the source who subsequently expressed its food preference was not a part of the show and was therefore unfamiliar to the infants.

Throughout the first two years of life, infants positively evaluate the prosocial and negatively evaluate the antisocial characters in this exact scenario. These evaluations are evident in infants' affiliative behavior (e.g., reaching; Hamlin & Wynn, 2011), in their social responses (e.g., who they give treats to and take treats away from; Hamlin, Wynn, Bloom, & Mahajan, 2011), and in their judgments of others who direct positive and negative behaviors to the prosocial and antisocial characters (Hamlin et al.,

[1] While to our knowledge there are no additional studies reporting selective learning from similar individuals in infancy, a large body of research suggests that preschool children gain information from similar over dissimilar others along multiple dimensions, preferring the same objects, foods, and activities as those who are similar to them in age (Shutts Banaji, & Spelke, 2010; c.f. VanderBorght & Jaswal, 2009), and who are their same gender (Bradbard & Endsley, 1983; Bradbard, Martin, Endsley, & Halverson, 1986; Martin, Eisenbud, & Rose, 1995; Martin & Little, 1990; Shutts et al., 2010).

2011). This breadth of social responses, as well as the use of puppets in many other studies of young children's social judgment and interaction (Olson & Spelke, 2008; Rakoczy et al., 2009; Vaish, Missana, & Tomasello, 2011), suggests that infants treat these puppets as social others who are appropriate to interact with, to evaluate, and (potentially) to use as a source of information. Here we examine this final suggestion, by asking whether a source's previous prosocial or antisocial behavior influences infants' tendency to match that source's food preference.

1. Method

1.1. Participants

Previous studies on selective learning in infancy have involved infants in the first half of the second year of life (Chow et al., 2008; Koenig & Woodward, 2010; Shutts, Condry, et al., 2009; Shutts, Kinzler, et al., 2009; Zmyj et al., 2010). As our procedure required grasping small items out of small bowls and eating finger foods, we chose to study 16-month-olds. Forty-eight infants were randomly assigned to three conditions: Prosocial Source (seven boys; mean age 16 months, 3 days, range 15 months, 15 days to 16 months, 25 days), Novel Source (eight boys; mean age 16 months, 0 days, range 15 months, 14 days to 16 months, 16 days), and Antisocial Source (seven boys; mean age 15 months, 26 days, range 15 months, 12 days to 16 months, 17 days). Nine additional infants were excluded due to parental interference (3), procedural error (2), or refusal to participate (4). Demographic information was collected from one third of participants; infants were 71% Caucasian/Non-Hispanic, 11% Caucasian/Hispanic, 6% Black/Non-Hispanic, 6% Native American/Hispanic, and 6% Native American/Non-Hispanic.

1.2. Stimuli and procedure

1.2.1. Eating warm-up

Infants sat on a parent's lap in the office waiting room. An experimenter holding a white bowl containing yellow Fruity Cheerios kneeled in front of the infant, said "Look!" and ate a Cheerio, saying "Mmm!" She then offered the bowl to the infant, encouraging the child to eat until the infant willingly tasted Cheerios twice.

1.2.2. Prosocial/antisocial puppet shows (viewable online at www.yale.edu/infantlab/socialevaluation_preferencematching)

Regardless of eventual source condition, all infants watched the same prosocial/antisocial puppet show. Infants sat in the parent's lap before a table with a curtain at its far end (165 cm from the infants) that could be lowered to occlude the show. Puppets were approximately 10 in. high. The protagonist puppet was always a brown dog, the prosocial and antisocial puppets were (counterbalanced across infants in each condition) a grey and an orange cat (Prosocial/Antisocial Source conditions) and a black & white and a grey cat (Novel Source condition). Parents were instructed to sit quietly with their infants and not attempt to influence them in any way.

Puppet shows were identical to those in Experiment 1 by Hamlin and Wynn (2011). During all trials, the curtain raised to reveal a stage surrounded on the sides and back by black curtains; the back curtain occluded a puppeteer. The prosocial and antisocial puppets sat at the rear corners of the stage, and a clear box containing a rattle rested in the middle. The protagonist entered from the back of the stage, moved toward one side of the box, and leaned its head down to look through the side of the box twice. It then attempted to lift the lid of the box four times, lifting slightly and dropping the lid twice, and then lifting slightly and lowering the lid twice. During the fifth attempt, the puppet on the opposite side of the stage from the protagonist (who entered on alternating sides of the box during each trial) intervened (see Fig. 1).

During prosocial events, the prosocial puppet ran to the front of the box, grabbed the corner of the lid, and opened it together with the protagonist. The protagonist dove down inside the box, grabbing the rattle. The prosocial puppet then ran off-stage, and the protagonist lifted the rattle from the box. All action ceased.

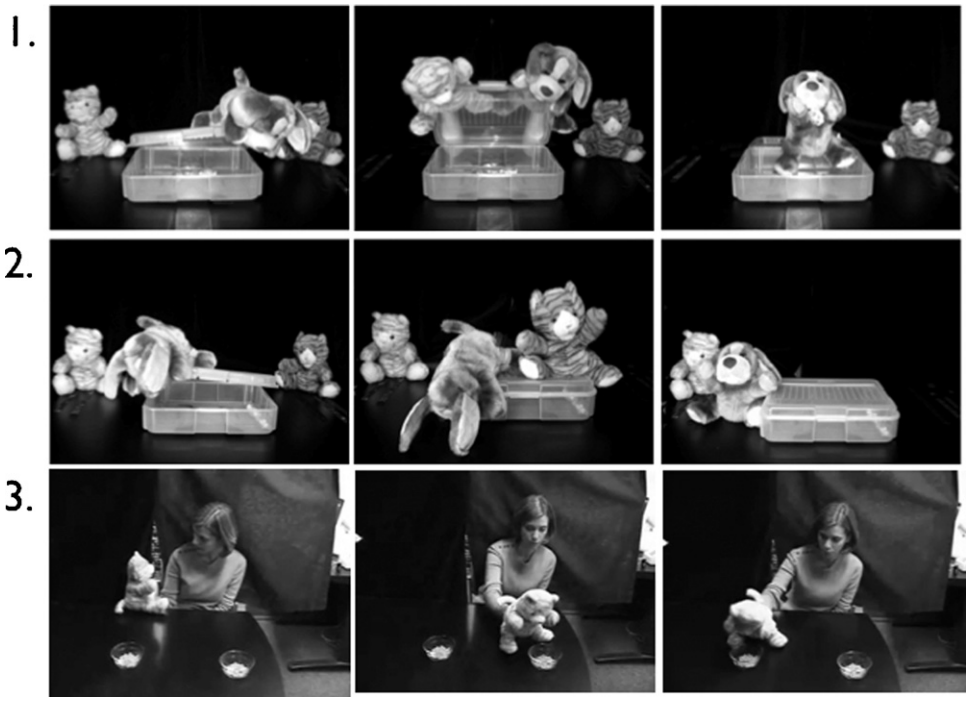

Fig. 1. Stimuli presented to infants: rows 1 and 2 represent the prosocial and antisocial puppet shows, in which a dog puppet tried but failed to open a clear box containing a rattle. On prosocial events (row 1) the prosocial puppet helped open the box and the dog obtained the rattle. On antisocial events (row 2) the antisocial puppet jumped on the box and the dog did not obtain the rattle. Row 3 represents the food preference presentation by a source who was previously either prosocial, novel, or antisocial.

During antisocial events, the antisocial puppet ran to the front of the box and jumped sideways onto the lid, slamming it shut. The protagonist dove down next to the box. The antisocial puppet then ran off-stage, and the protagonist sat up next to the box. All action ceased.

Both prosocial and antisocial events lasted approximately 15 s. An independent coder recorded infants' looks to the display through a hole in the curtain from the time action ceased until the infant looked away for two consecutive seconds, or until 30 s elapsed, as in previous studies (Hamlin, Wynn, & Bloom, 2007; Hamlin, Wynn, & Bloom, 2010; Hamlin et al., 2011). Infants were familiarized to three prosocial and three antisocial events presented in alternation, for six total events. The following were counterbalanced across infants within each condition: color of prosocial/antisocial puppets (black & white or grey for the Novel Source condition, and grey or orange for the Prosocial/Antisocial Source conditions), side of prosocial puppet during events (right or left side of stage), and order of prosocial events (first or second).

1.2.3. Preference display (viewable online at www.yale.edu/infantlab/socialevaluation_preferencematching; see Fig. 1)

Infants sat on the parent's lap at a table, approximately 105 cm from the experimenter who had performed the eating warm-up. (This experimenter had not observed the prosocial/antisocial puppet show and was therefore blind to the identity of the source puppet in the Prosocial and Antisocial Source conditions.) Parents were asked to close their eyes. The experimenter placed two clear bowls on the table in front of her, approximately 30 cm apart, one containing red Fruity Cheerios and one containing purple Fruity Cheerios.

The experimenter brought out an orange cat puppet (the Prosocial, Novel, or Antisocial Source) on her right hand and spoke to it, saying "Hi Kitty!" and making it wave to the infant. She then asked the

source puppet: "Do you want to try some?" and made it nod "yes" toward the infant. The experimenter then moved the source puppet toward one of the food bowls, 'tasting' the Cheerios in it by leaning into and out of the bowl and making eating sounds. After tasting, the source puppet expressed either a positive ("Mmmm! Yum! I like that!" in a high-pitched, positive voice) or negative ("Blech! Yuck! I don't like that!" in a low-pitched, negative voice) opinion of the Cheerios inside. After expressing its preference, the source puppet moved back toward the experimenter, who asked: "Do you want to try the other one?" and made it nod "yes" toward the infant. The source then tasted from the second bowl and expressed the opposite opinion.

Each infant saw the source taste both the red and purple Cheerios, expressing liking for one and disliking for the other. After the taste preferences were modeled, the experimenter said "Thanks Kitty! Bye bye!" and the source puppet waved to the infant and left.

Because they were asked to close their eyes for the preference display, parents knew neither the identity of the source puppet nor which food it preferred. The experimenter was blind to the previous behavior of the source puppet in the Prosocial and Antisocial Source conditions. The following were counterbalanced across infants: location of red Cheerios, whether red Cheerios were liked or disliked, and whether liking or disliking was expressed first.

1.2.4. Food choice

The experimenter made eye contact with the infant, pushed the two food bowls within his or her reach, and said, "Do you want to try some?" She then waited until the infant had made four consecutive food choices. The experimenter used a variety of ways to encourage infants to eat. Encouragement was permissible as long as an infant was not currently holding any Cheerios, nor had his or her hands in either bowl, to avoid prompting the infant to eat from a particular bowl. If the infant was distracted, the experimenter shook both bowls or knocked them together lightly and repeated the invitation to try some. If the infant seemed reluctant to try any Cheerios, the experimenter encouraged eating by saying, "It's OK, you can try some," or "You can eat some if you want." Although parents were instructed before the study not to talk to their infants during the task, if infants were very reluctant to eat, the experimenter prompted parents to tell the infant, "It's OK." Eating and encouraging continued until infants had made four clear food choices.

1.3. Coding

1.3.1. Attention following puppet shows

Infants' attention was coded by an online coder following each puppet show (from the time action ceased, as described above). We calculated how long infants watched following prosocial puppet events and following antisocial puppet events to examine whether this influenced infants' later food choices. A second independent coder coded a random 25% of infants' attention in each condition. The inter-rater correlations were .995, .98 and .97 for the Prosocial, Novel, and Antisocial Source conditions, respectively.

1.3.2. Attention coding to food preference display

To examine the effect of infants' attention to the sources on eating behaviors, an independent coder (blind to condition) coded each infant's attention to the food preference display from videotape. Because preference was displayed live and there were therefore small differences in the total length of each presentation, we also coded the total display length for each infant and determined the proportion of the total display time that each infant attended to. A second independent coder coded a random 25% of infants' attention in each condition. The inter-rater correlation coefficient was .77.

1.3.3. Food choice coding

The experimenter coded infants' choices as the first four times an infant grasped one or more Cheerios from a bowl and ate them without interruption. "Interruptions" were coded as any behavior

that could have led to an infant not knowing which bowl a Cheerio had come from[2] and took a variety of forms, including dropping Cheerios onto clothing or the table and later finding and eating them, picking up multiple different-colored Cheerios with both hands and moving them back and forth between their hands. The experimenter determined whether a choice had been interrupted. Eating continued until the infant made four non-interrupted choices. Each infant received a score indicating the number of trials (of four) in which they ate the food the puppet model had liked.

An independent coder blind to the model's identity recoded a randomly chosen 25% of infants' choices and agreed with the original experimenter on 100% of trials.

2. Results

2.1. Attention to puppet events

Collapsed across condition, infants looked longer at prosocial puppet show events (mean = 32.58 s of total looking over three trials, SEM = 3.35) than antisocial puppet show events (mean = 26.25 s, SEM = 2.69); $F(1,47) = 10.08$, $p < .005$, $\eta_p^2 = .18$. This tendency did not differ across conditions, $F(2,45) = .75$, $p = .48$, $\eta_p^2 = .03$, nor did infants' relative attention to prosocial versus antisocial events (adding this as a covariate in the choice analyses) influence their food choices across condition, $F(1,46) = .004$, $p = .95$, $\eta_p^2 = .00$, or within any condition alone (all $ps > .28$).

2.2. Attention to the preference display

Infants in the Prosocial Source condition looked to the presentation an average of 95% of the time (SEM = 1%); infants in the Novel Source condition looked an average of 95% of the time (SEM = 1%), and infants in the Antisocial Source condition looked an average of 96% of the time (SEM = 1%).[3] This measure did not differ across condition according to a univariate analysis of variance (ANOVA), $F(2,40) = .32$, $p = .73$, $\eta_p^2 = .02$), and when added as a covariate did not significantly influence infants' food choices across condition, $F(1,39) = .76$, $p = .40$, $\eta_p^2 = .02$, or within any condition ($ps > .35$).

2.3. Food choice

Infants' food choices by condition are represented in Figs. 2 and 3. A univariate ANOVA including condition, sex of infant, order of prosocial action during familiarization, color of liked Cheerios, and order of liking event as between-subject factors, and including age as a covariate revealed only an effect of condition on infants' food choices, $F(2,45) = 6.094$, $p < .05$, $\eta_p^2 = .484$, and no significant interactions. Planned contrasts using one-sample t-tests revealed that infants in the Prosocial Source condition significantly ate the source's preferred over dispreferred food, mean (SEM) = 3.0(.27); $t(15) = 3.65$, $p < .005$, as did infants in the Novel Source condition, mean (SEM) = 2.88(.26), $t(15) = 3.42$, $p < .005$. In contrast, infants who saw the antisocial puppet's food preference ate the two foods equally, mean (SEM) = 1.69(.25); $t(15) = -1.23$, $p = .24$. This significant tendency to match the source's preference in the Prosocial and Novel Source conditions but not in the Antisocial Source condition was evident in non-parametric Kolmogorov–Smirnov one-sample tests, D_{max}(Prosocial) = .437, $p < .01$, D_{max}(Novel) = .375, $p < .05$, D_{max}(Antisocial) = .187, $p > .05$, and in individual infants' patterns of response. That is, 12 of 16 infants chose the Prosocial Source's preferred food more than half the time (on three or four of four choices, chance = 31.5%, binomial test, $p < .001$), 11 of 16 infants in the Novel Source condition did so (binomial test, $p < .005$), and only two of 16 infants in the Antisocial Source

[2] While our two foods were distinguishable by both color and location, it is unclear which of these cues infants used to distinguish them. Recent work suggests that young infants may not yet categorize food types as adults do (i.e., uniquely by substance; Birch, 1980; Brody & Stoneman, 1981; c.f. VanderBorght & Jaswal, 2009; Hendy & Raudenbush, 2000; Jaswal & Neely, 2007; Shutts, Condry, Santos, & Spelke, 2009).

[3] Due to equipment error, video data were lost from two infants in the prosocial and three infants in the antisocial condition; this analysis therefore includes data from the remaining 14 and 13 infants in those two conditions, respectively.

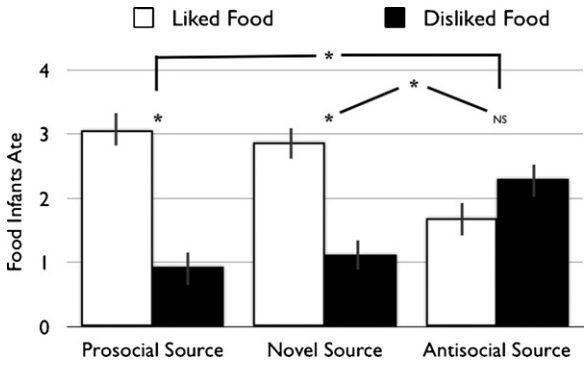

Fig. 2. Results: number of times (of four) infants ate liked versus disliked food following preference modeling by Prosocial, Novel, or Antisocial Source.

condition did so. Further analyses revealed that infants were significantly more likely to match the preference of the Prosocial Source than the Antisocial Source, $t(30) = 3.52$, $p < .005$; Fisher's exact test $p < .001$. They were also more likely to match the preference of the Novel Source than the Antisocial Source, $t(30) = 3.29$, $p < .005$, Fisher's exact test, $p < .005$, but equally likely to match the preference of the Prosocial and Novel Source, $t(30) = .333$, $p = .71$, Fisher's exact test, $p = .99$.

3. Discussion

Results suggest that infants gain information from certain individuals and ignore information from others. When presented with the food preferences of a puppet who had previously been prosocial toward a third party, infants chose the food the puppet had expressed liking over the food it expressed disliking for. In contrast, when a previously antisocial puppet presented its preferences, infants did not appear to take this information into account in deciding what to eat, choosing both the liked and disliked foods equally. Comparing these results with those in the Novel Source condition suggests that this effect is driven by a relative failure to match the food preferences of antisocial others: infants were equally likely to match the food preferences of an unknown and a prosocial source. Taken together, these results support the claim that one's evaluation of a potential source of information may contribute to selective learning in infancy.

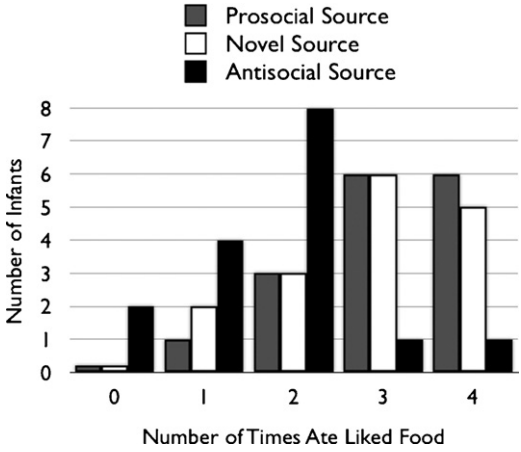

Fig. 3. Results: number of infants who matched the source's preference zero, one, two, three or four of four times following preference modeling by Prosocial, Novel, or Antisocial Source.

Note, however, that the current study did not directly test whether infants positively evaluated the prosocial character and negatively evaluated the antisocial character. We chose not to examine infants' preferences in order to avoid influencing their subsequent interactions with the puppets. Instead, infants' evaluations were inferred from previous studies – all using the box scenario utilized here – which have demonstrated that (1) infants prefer the prosocial to the antisocial character (Hamlin & Wynn, 2011), (2) infants prefer those who help the prosocial character and those who hinder the antisocial character (Hamlin et al., 2011), and (3) toddlers themselves give treats to the prosocial character and take treats away from the antisocial character (Hamlin et al., 2011). Together, these results strongly suggest social evaluation is taking place in the present study; however, we acknowledge that inferred evaluation is a potential limitation of the results.

Importantly, the observed effects cannot be accounted for by attentional differences: infants were as likely to attend to the preferences of Prosocial, Antisocial, and Novel Sources, and their attention following prosocial and antisocial events did not influence their food choices. It is additionally difficult to explain this pattern of results as stemming from purely associative mechanisms. Because all infants saw both prosocial and antisocial puppet events, we can be sure that they did not, for example, simply feel less social after viewing antisocial events and subsequently fail to take in any source's information. In addition, because all sources expressed both positive and negative food preferences, infants could not have simply tagged food items with positive versus negative emotional information without also considering the source of that information, nor could they have merely responded to the presence of positive versus negative sources without considering the specific preference information. Finally, as all infants were provided with only one potential source of information, they could not have based their responses on whether one source was relatively preferable to another source, but only on whether the only source available had information worth using.

There are several ways to interpret these results. One possibility is that infants considered a source's emotional information to reflect its individual preference. Previous research has shown that by 13 months of age, infants expect some kinds of information (e.g., language) to be shared across individuals but appreciate that other kinds of information (e.g., object preferences) may differ from one individual to another (Buresh & Wooward, 2007; Repacholi & Gopnik, 1997). If infants interpreted the puppet's expressions to reflect personal attitudes about the foods, our results may reflect infants' desire to affiliate with and/or "be like" the Novel and Prosocial Sources, but not the antisocial source. While the puppet model itself was not present during infants' eating test (and was therefore perhaps unavailable for affiliation), the puppeteer experimenter was present, which may have exerted a social influence on infants' choice. Research with children and adults suggests that imitative behavior is both cause and consequence of a drive to affiliate (Chartrand & Bargh, 1999; Lakin & Chartrand, 2003; Over & Carpenter, 2009; Over & Carpenter, 2012; Uzgiris, 1981). Our results suggest that this link between imitation/emulation and liking may be present in infancy.

Alternatively, infants may have taken the sources' expressed preference information to be about the actual state of the world (i.e., that a particular food is good and another food is bad). If so, infants' selectivity may reflect lower levels of trust in the accuracy of information provided by an Antisocial Source, similarly to how older children believe that a previously inaccurate labeler may also have incorrect knowledge of other object names (Birch & Bloom, 2002; Sabbagh & Baldwin, 2001). On this explanation, we would expect infants to avoid the Prosocial or Novel Source's disliked Cheerio color in new situations in which neither puppet nor puppeteer is present.

Finally, this study is limited in that the puppets' behavior was the only information infants had about their potential value as knowledge sources. In the real world, learners often know much more in addition to a source's immediate behavior, such as their prior behavioral history, skills in different areas, and group memberships, We may also know something about the target of one's behaviors, such as whether the targets themselves are good or bad, or whether or not they are in our group. Infants' evaluations of helpful and unhelpful characters are known to differ depending on the past acts of the target of those characters' behaviors (Hamlin et al., 2011); perhaps infants' judgments of the Antisocial Source might have differed had they known more about the source itself (for instance, if it were an in-group member) or more about the target of the Antisocial Source's behavior (for instance, if the target were bad or an out-group member). Further study should attempt to tease apart these possibilities to shed light on the role of affiliation and liking in social learning.

Interestingly, infants in the present studies were equally likely to match the food preferences of the Prosocial and Novel Sources, relative to their reluctance to match the Antisocial Source, whom they neither matched nor mismatched. While our results may represent a ceiling effect on preference matching of the prosocial and neutral sources, and further study could show that prosocial sources are privileged over neutral ones, infants in both the Prosocial and Novel Source conditions did sometimes eat the foods their source had disliked (on average once of four times), making this possibility somewhat less plausible. Our results suggest that the baseline response may be to accept others' information unless they present some reason not to (in this case, being antisocial). This response pattern would be adaptive (more learning may be better) and is reminiscent of the negativity bias, in which negative (relative to positive or neutral) individuals and actions may be particularly salient, influential, and memorable to adult and child observers (Abelson & Kanouse, 1966; Aloise, 1993; Kanouse & Hanson, 1972; Knobe, 2003a; Leslie, Knobe, & Cohen, 2006). These results support claims that the negativity bias is early-developing (Hamlin et al., 2010; Vaish, Grossman, & Woodward, 2008), and is also highly consistent with recent reports of a "pitchfork effect" in preschoolers' selective learning: Being previously inaccurate has a relatively greater influence on children's tendency to gain information from a source than does being previously accurate (Corriveau, Meints, & Harris, 2009; Koenig & Jaswal, 2011).

Overall, these results indicate that infants are selective not only in what kinds of information they gain from social sources, but also regarding which sources they receive information from. While we have not yet accounted for the specific mechanism leading to infants' responses (accuracy, familiarity/similarity, liking), our findings add to the small but expanding literature on selective source learning and imitation in infancy (Chow et al., 2008; Koenig & Woodward, 2010; Nielsen, 2006; Nielsen et al., 2008; Ryalls et al., 2000; Shutts, Condry, et al., 2009; Shutts, Kinzler, et al., 2009; Zarbatany & Lamb, 1985; Zmyj et al., 2010), as well as to recent evidence that infants evaluate others based on their pro- and anti-social behaviors (Dunfield & Kuhlmeier, 2010; Geraci & Surian, 2011; Hamlin & Wynn, 2011; Hamlin et al., 2007; Hamlin et al., 2010; Schmidt & Sommerville, 2011), and calls for further elucidation. If simply seeing an individual behave antisocially toward an unknown third-party decreases infants' tendency not only to interact with that individual, but also to use that individual as a source of new information, early developing mechanisms for social evaluation may, over time, have lasting effects on development.

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