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Authors

Pronovost, Megan A
Scott, Rose M

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20-month-olds use social categories to make inductive inferences about agents' preferences

Megan A. Pronovost*

California State University, Fresno

Rose M. Scott

University of California, Merced

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*Corresponding author:
Megan A. Pronovost
Department of Child and Family Science
California State University, Fresno,
5300 N Campus Drive, M/S FF12
Fresno, CA 93740
megpronovost@csufresno.edu

Abstract

Adults use social-group membership to make inductive inferences about the properties of novel individuals, and this tendency is well established by the preschool years. Recent evidence suggests that infants attend to features associated with social groups and use social-group membership to interpret an agents' actions. The current study sought to replicate and extend these findings by clarifying whether infants' responses in prior studies reflected 'in the moment' influences of social-group membership or inductive inferences about agents' properties and behaviors. Specifically, we investigated whether 20-month-old infants expect members of a social group to share characteristics, even when the target agent acts alone in the absence of other group members. Our results demonstrated that infants expected two individuals to share food preferences when they belonged to the same social group, but they had no expectations about whether members of two different social groups would share food preferences. These results suggest that by 20 months of age, infants use social-group membership to make inductive inferences about the properties of novel individuals, even when that individual is acting in the absence of its group members.

Keywords: inductive inference; social cognition; infancy; social categorization

Adults often assume that social categories capture fundamental similarities amongst individuals and hence use social category membership to make inductive inferences about the likely properties and behaviors of novel individuals (e.g., Hammond & Cimpian, 2017; Kalish, 2012; Prentice & Miller, 2007). The tendency to make these inductive inferences is well established by the early school years (e.g., Bigler et al., 1997; Birnbaum et al., 2010; Diesendruck & HaLevi, 2006; Waxman, 2013). For instance, 5-year-olds expect that individuals who are the same ethnicity will prefer the same activities (Diesendruck & HaLevi, 2006) and share biological (e.g., blood type) and psychological (e.g., beliefs) properties (Birnbaum et al., 2010), and preschoolers expect members of the same sex to prefer the same toys (Martin et al., 1995).

When and how does the tendency to make social-category based inductive inferences develop? Sensitivity to social categories has roots in infancy. By 3 months, infants living in primarily own-race environments prefer to attend to own-race faces over other-race faces (Bar-Haim et al., 2006). Infants in the first year of life also preferentially attend to, accept toys and food from, and imitate actions produced by speakers of their native language over foreign-language speakers (e.g., Howard et al., 2015; Kinzler et al., 2007; Shutts et al., 2009). These findings suggest that infants notice perceptual features that are associated with social-category membership.

By the second year of life, infants go beyond detecting the perceptual correlates of category membership and spontaneously categorize novel individuals (Jin & Baillargeon, 2017; Liberman et al., 2016; Powell & Spelke, 2013; Rhodes et al., 2015). For example, Powell and Spelke (2013) tested 12-month-olds in a violation-of-expectation task involving two social groups, each composed of three identical animated shapes. The members of each group first engaged in a synchronized activity. Next, while all of the figures were present, a member of one group performed an action (jumping) and a member of the other group performed a different action

(sliding). These respective actions were repeated by a second member of each group. The final member of each group then performed one of the two actions. Infants looked reliably longer if the final agent performed an action that was inconsistent, as opposed to consistent, with the actions of its group members. Additional conditions showed that infants did not display these expectations if the objects were inanimate or did not initially engage in synchronized activity. Together these findings suggest that infants were not merely responding to low-level perceptual similarity: they categorized the individuals into social categories based on their appearance and shared activity and used category membership to predict and interpret the agents' actions.

Other studies have investigated additional cues to group membership and other group-based behaviors (Jin & Baillargeon, 2017; Liberman et al., 2016). In a study by Liberman and colleagues (2016), 14-month-olds first watched an introduction phase where two agents (Agent-1 and Agent-2) either affiliated positively by turning towards one another and saying "Hi" in a positive tone or disengaged by turning away from one another and saying "Hmph" in a negative tone. Infants then saw familiarization trials in which Agent-1 and Agent-2 were seated behind two bowls of food (bowl-A and bowl-B). Agent-1 ate from bowl-A and expressed that she liked the food by saying, "Ooh. I like that!" in a positive tone. In the subsequent test phase, Agent-2 ate from either bowl-A or bowl-B on alternating trials and expressed dislike by saying, "Ew. I don't like that" in a negative tone. When the agents had previously interacted positively, infants looked longer at trials where Agent-2 disliked bowl-A as opposed to bowl-B, suggesting that the infants expected Agent-2 to have the same reaction to the food in bowl-A as Agent-1 and hence looked longer when she did not. In contrast, infants who saw the agents disengage instead looked longer when Agent-2 expressed dislike at bowl-B, suggesting they did not expect her to have the same reaction as Agent-1 and instead looked longer at the perceptually novel event.

These prior studies suggest that infants in the second year of life can spontaneously categorize agents into social groups using several different cues and then use group membership to interpret agents' actions (Jin & Baillargeon, 2017; Liberman et al., 2016; Powell & Spelke, 2013; Rhodes et al., 2015). However, the type of inferences that infants were making about the target agent's behavior remains somewhat unclear. One possibility is that infants, like older children and adults, use group membership to make inductive inferences about properties of the agent. If so, then after observing some group members engage in an activity (Powell & Spelke, 2013) or emote positively towards a food (Liberman et al., 2016), infants might have inferred that members of this group prefer this activity/food (e.g., stars like to slide). They then used the target agent's group membership to make an inference about that agent's preferences, expecting them to prefer the same activity/food as other group members.

An alternative possibility is that infants' responses reflected 'in the moment' influences of social-group membership rather than inductive inferences about the properties of category members. Several studies suggest that infants, toddlers, and preschoolers expect people to alter their behavior when group members are present (Engelmann et al., 2018; Engelmann et al., 2013; Bian et al., 2018). For instance, 1.5-year-olds expect an individual to distribute resources differently with group members (Bian et al., 2018) and 5-year-olds are more likely to behave prosocially if they think a member of their group is watching them (Engelmann et al., 2018; Engelmann et al., 2013). Moreover, by 14 months, infants are more likely to imitate members of their own social group than members of other groups (Buttelmann et al., 2013; Howard et al., 2015). These findings raise the possibility that when infants observe an agent acting in the presence of group members, they expect the agent to conform to social pressure or to imitate the actions that they see their group members perform. This would still indicate that infants use social-group

membership to reason about how an agent will behave, but it would suggest a transient influence of group membership (e.g., this star will slide because it just saw other stars slide) as opposed to inductive inferences about the properties of an individual (e.g., this star will slide because it *likes* to slide). Because the target agent always acted in the presence of its group members in prior studies (Jin & Baillargeon, 2017; Liberman et al., 2016; Powell & Spelke, 2013; Rhodes et al., 2015), it is not currently possible to tease apart these two possibilities.

Thus, the current work had three goals. First, we sought to replicate prior findings that infants can categorize individuals into social groups and use group membership to interpret their actions (e.g., Liberman et al., 2016; Powell & Spelke, 2013). There is a growing interest in the origins of social-category based reasoning and its influence on early social cognition and learning (Jin & Baillargeon, 2017; Liberman et al., 2016; Liberman et al., 2017; Rhodes et al., 2015; Rhodes & Mandalaywala, 2017; Ting, He, & Baillargeon, 2019). We reasoned that a successful replication would contribute to this growing body of work by demonstrating that infants' ability to form and reason about novel social categories is robust, thereby providing additional support that social-category based reasoning has its roots in infancy.

Our second goal was to extend prior work by clarifying whether infants in prior studies were responding based on 'in the moment' influences of group membership or using group membership to make inductive inferences about the properties of agents. To tease apart these two possibilities, in the current study we examined the inferences that infants make about an agent's behavior when that agent is acting in the absence of group members. If infants expect an agent to behave similarly to other group members, even when acting alone, this would suggest that they can use group membership to make inductive inferences about an agent's preferences.

An ancillary goal of this study was to explore the cues that infants use to identify social categories with inductive potential. Recent studies suggest that infants can identify social categories that are marked by affiliative behaviors (Liberman et al., 2016), physical appearance and shared activity (Powell & Spelke, 2013), or shared noun labels (Jin & Baillargeon, 2017). Here we asked whether infants could also identify social groups that were marked with adjectives, a linguistic marker that adults readily use to identify group membership (i.e. "I'm British."). By 18 months, infants display some awareness of the differences between nouns and adjectives (e.g., Booth & Waxman, 2003; Waxman & Booth, 2001; Waxman & Markow, 1995) and they use nouns ("This is a blick") but not adjectives ("This is blickish") to make inductive inferences about the nonobvious properties of novel objects (e.g., Graham et al., 2004; Keates & Graham, 2008). It is an open question whether infants make a distinction between nouns and adjectives when reasoning about social categories.

To address these goals, we examined whether 20-month-old infants expected an agent to share a group member's food preference when acting in their group members' absence. Our experimental approach was based on prior evidence that by 18 months, infants treat preferences as agent-specific by default (Buresh & Woodward, 2007; Egyed et al., 2013; Henderson & Woodward, 2012). Thus, when infants observe an agent demonstrate a preference for object-A over object-B and then see a second agent, who does not obviously share a social category with the first, they hold no expectations about which object the second agent will prefer. This allowed us to test whether social-group membership overrides this default behavior: would infants expect the second agent to share the first agent's preference if they were members of the same social category?

Infants were tested in a violation-of-expectation task involving two novel social groups, Topids and Brinkos, that were identified by physical appearance and novel words (either nouns or adjectives). Multiple cues to group membership were used based on prior evidence that infants more readily represent social categories when members share physical appearance, but they are unable to represent these categories based on physical appearance alone (Powell & Spelke, 2013). After being introduced to the social groups, infants saw familiarization trials in which a Topid established a preference for one of two foods. In the test trial, infants either saw a member of the same group (another Topid; same-group condition) or a member of a different group (a Brinko; different-group condition) choose between the two foods.

Based on prior evidence that infants this age do not readily generalize preferences across agents who do not obviously share a social group (e.g., Buresh & Woodward, 2007), we predicted that infants in the different-group condition should have no expectations about the Brinko's food preference in the test trial and thus should look equally regardless of whether she picked the same or a different food as the Topid had picked in the familiarization trials. If infants in the prior social-group studies described above (e.g., Liberman et al., 2016; Powell & Spelke, 2013) were responding based on 'in the moment' influences of group membership, then infants in the same-group condition should behave similarly to those in the different-group condition: because no other group members were present, they should have no expectations about which food the Topid should select in the test trial. If, however, infants can use group membership to make inductive inferences about an agent's preferences, then infants in the same-group condition should respond differently from those in the different-group condition: they should expect the Topid in the test trial to have the same preference as the Topid in the familiarization trial and hence look longer if the Topid in the test trial picked a different food instead. Finally, if infants treat adjectives differently from

nouns, then infants should only expect members of the same social group to share preferences when the agents initially identified their social-group membership using nouns.

Method

Participants

72 healthy infants participated (36 female; M_{age} = 19 months, 28 days, range 18 months, 7 days – 22 months, 15 days). An a priori power analysis was conducted using G*Power3.1 (Faul, Erdfelder, Buchner, & Lang, 2009); an effect size of η_p^2 = .14 was assumed based on the average effect sizes reported in two similar studies (Henderson & Woodward, 2012; Luo & Baillargeon, 2005). This analysis indicated that n = 72 was sufficient to achieve at least .90 power with an alpha of .05 in our main analysis (an F-test in an ANCOVA with 8 groups and a single covariate). Another 19 infants were tested but excluded because they were crying (n = 1), active (defined as high levels of physical activity and active attempts to get off parent's lap in at least 4 of 5 trials, n = 4), or failed to complete the experiment (n = 9), because of parental interference (n = 4), or because their test looking time was over 2.5 SD away from the mean of their condition (n = 1)[1]. Equal numbers of males and females were randomly assigned to each combination of the group (same-group, different-group) and word (noun, adjective) conditions.

The infants' names were obtained from birth records provided by the California Department of Public Health, as well as from a database of parents who had previously expressed interest in participating in research studies with their children. Parents were reimbursed for their transportation expenses and infants received a small gift for participating. Parents provided written informed consent for their infant's participation. The Institutional Review Board at University of California Merced approved all procedures.

[1] Inclusion of this outlier does not change the patterns of significance reported in the Results section.

The racial and ethnic composition of the final sample was 54% White, 6% Asian, 1% American Indian or Alaska Native, 1% Black or African-American; an additional 7% chose 'other race', 20% selected more than one race, and 11% chose not to respond. 39% of the sample identified as Hispanic or Latino, 55% identified as not Hispanic or Latino, and 6% chose not respond. We recorded the highest level of education reported by either parent: 28% completed high school, 11% completed an Associate's degree, 26% completed a Bachelor's degree, 18% completed a Master's degree, 10% completed a professional degree, and 7% chose not to respond.

Stimuli

Stimuli were high-definition videos of human actors. All infants saw a group-induction trial, three familiarization trials, and one test trial. A separate video was played for each trial. Each trial consisted of a 10-second initial phase followed by a final phase. The duration of the initial phase was fixed and identical for all participants. The duration of the final phase was infant-controlled. All trials are described from the infants' perspective.

Group-induction trial

At the start of the group-induction trial, three female actors sat around a table (see Figure 1). The actors looked dissimilar on multiple features (hair color, hair style, etc.) to help infants tell them apart and they were all different ethnicities, ensuring there was no relationship between ethnicity and membership in our arbitrary social groups.

In the *same-group condition*, two actors (Topid-A, Topid-B) wore pink turtlenecks and yellow visors while the third (Brinko-A) wore a plaid shirt and a propeller hat. In the *different-group condition*, Topid-B was replaced by Brinko-B, who wore a plaid shirt and a propeller hat.

During the initial phase of the trial, the actors identified their social-group membership using a novel noun ("Topid" or "Brinko") or adjective ("Topish" or "Brinkish"). As each actor

spoke, she looked back and forth between the other actors. When not speaking, the actors looked at the person speaking. After all actors finished speaking, they looked down and paused. The infants viewed this paused scene until the trial ended (see Apparatus and procedure section for trial-ending criteria).

Familiarization trials

In the first familiarization trial, Topid-A sat behind a table; the other two actors were not present (see Figure 2). Two white plates (18 cm in diameter) were centered in front of Topid-A on the table (25 cm apart). The right plate held purple pasta and left plate held blue cereal. During the initial phase, Topid-A selected one of the foods, ate it, then said, "Mmm!" and smiled. She then looked down at the center of the table and paused until the trial ended. This procedure was repeated in familiarization trials two and three, with Topid-A selecting the same food each time. These familiarization trials thus demonstrated that Topid-A preferred the selected food over the non-selected food. Topid-A's food preference was counterbalanced across infants: half saw her choose the purple food three times, and the other half saw her choose the blue food three times. For ease of description, the test trials are described from the perspective of infants who saw Topid-A choose blue cereal in the familiarization trials.

Test trials

The infants received either a same-food or different-food test trial (see Figure 3). Initially, no actors were present. The plates of food again sat on the table (the sides of the foods varied across participants). During the initial phase of the trial, Topid-B or Brinko-B entered from the left and sat down. She selected a piece of blue cereal (same-food event) or purple pasta (different-food event), ate it, then said, "Mmm!" and smiled. She then looked down at the table and paused until the trial ended. Note that all infants saw the same actor in the test trial. All that differed across

conditions was her outfit and whether she had previously identified herself as Topid/Topish or Brinko/Brinkish. Any observed differences in looking times across conditions could therefore not be due to a preference for a particular individual.

Apparatus and procedure

Infants sat on their parent's lap 91.5 cm in front of a large television screen (68.5 cm x 122 cm). The room was dimly lit. A camera hidden below the television (centered, 89 cm above the floor) recorded the infant's face. Parents were instructed to close their eyes or look down to avoid biasing their infant's responses.

The television was connected to a computer located to the infant's left behind a sound-dampening room divider. The computer controlled the presentation of the stimuli using PsychoPy (Peirce, 2007). The software selected the correct version of each trial based on the infant's condition and presented the video in the center of the television screen (each video measured 64 cm x 37 cm on screen). An experimenter observed the infant on a monitor and pressed a button on the keyboard whenever the infant attended to the video. The software separately computed looking times for the initial and final phases of each trial; looking times during the final phase were used to determine when each trial ended. In between trials, an attention-getter (a yellow smiley face measuring 28 cm x 20 cm) was displayed on the screen for 4 seconds and a brief tone was played to attract the infant's attention to the television screen.

At the start of the experiment, the attention-getter was presented in the center of the television screen. When the infant attended to the screen, the experimenter initiated the presentation of the stimuli. Infants viewed the group-induction trial appropriate for their condition, followed by three familiarization trials. Each trial ended when the infant either (1) looked away for 2 consecutive seconds after having looked for at least 4 cumulative seconds or (2) looked for

60 cumulative seconds without looking away for at least 2 consecutive seconds.

Infants then viewed the test trial that was appropriate for their condition; half the infants in each condition saw the same-food event and half saw the different-food event. This trial ended when infants (1) looked away for .5 consecutive seconds after having looked for at least 5 cumulative seconds or (2) looked for 30 cumulative seconds without looking away for at least .5 consecutive seconds.

Coding and analysis

In order to present infant-controlled events, online coding was conducted by an experimenter (blind to condition and test trial), as described above. All infants were then coded offline from silent video by two trained coders who were blind to the condition and test trial that the infant received (coders could not see or hear the events that the infants were shown); the looking times resulting from the offline coding were used in all analyses. For each trial, the coders indicated the infant's direction of gaze (at the stimuli or away) for each frame of the video. The two offline coders agreed on the child's direction of gaze for 95% of video frames. Trials in which agreement between the coders was less than 90% (20/360) or the coders disagreed on whether the child met the criteria to end the trial (5/360) were resolved by a third coder.

The infants were highly attentive during the initial phases of the events, attending on average for 96% of the initial phases of all trials (group-induction: 94%; familiarization: 97%; test: 97%). To control for possible baseline differences in infants' attentiveness to the final paused scenes, we averaged infants' looking times during the final phases of the group-induction and familiarization trials and included this variable as a covariate in all analyses of the test trials.

Preliminary analyses of the test data indicated no significant interactions of condition and test event with sex, the color of the food selected in the test trial, or the side of the actor's reach in the test trial, all Fs < 1. The data were collapsed across these factors in subsequent analyses.

Results

Infants' looking times in the test trial (see Figure 4) were analyzed with an analysis of covariance (ANCOVA) with group condition (same-group, different-group), word condition (noun, adjective), and test event (same-food, different-food) as between-subjects factors, and infants' average looking times during the final phases of the group-induction/familiarization trials as a covariate. Results revealed a main effect of event, $F(1, 63) = 12.05$, $p = .001$, $\eta_p^2 = .16$. This effect was qualified by a significant interaction of group condition and event, $F(1, 63) = 10.35$, $p = .002$, $\eta_p^2 = .14$. No other effects were significant, all Fs < .75, ps > .39.

Planned comparisons revealed that in the same-group condition, the infants who received the different-food event ($M = 17.5$, $SD = 6.8$) looked reliably longer than those who received the same-food event ($M = 9.34$, $SD = 2.7$), $F(1, 63) = 21.77$, $p < .001$, $\eta_p^2 = .26$. In the different-group condition, the infants looked about equally whether they received the different-food event ($M = 12.6$, $SD = 6.4$) or the same-food event ($M = 12.3$, $SD = 4.7$), $F < 1$.

These results suggest that the infants in the same-group condition expected members of the same social group to share food preferences, and they looked longer if they had different food preferences instead. In contrast, the infants in the different-group condition held no expectations about which food the agent would select in the test trial. The absence of any effects or interactions involving word condition suggests that these expectations held regardless of whether the agents identified their group membership with a novel noun or adjective. Together these results suggest

that by 20 months, infants use social-group membership to make inductive inferences about an agent's food preferences, even when that agent acts in the absence of other group members.

Further results

A possible alternative interpretation is that infants were unable to tell the two Topids apart. If so, then the infants in the same-group condition might have thought that the agent in the test trial was the same agent that they had seen in the familiarization trials and hence looked longer at the different-food event because that agent appeared to suddenly change food preferences. To address this possibility, an additional group of 12 infants (M_{age} = 19 months, 14 days) were tested in an actor-discrimination condition adapted from Buresh and Woodward (2007)[2]. Infants first saw the group-induction and familiarization trials from the same-group noun condition. Infants then viewed two test trials in which either Topid-A (old-actor event) or Topid-B (new-actor event) entered and ate the same food that Topid-A had selected during the familiarization trials (order counterbalanced). The infants' looking times during the test trials were analyzed using an analysis of variance (ANOVA) with test event (old-actor event, new-actor event) as a within-subjects factor and event order as a between-subjects factor. The analysis yielded a main effect of event, indicating that the infants looked longer at the new-actor event (M = 11.4, SD = 4.6) than the old-actor event (M = 7.3 SD = 2.2), $F(1,10) = 9.08$, $p = .013$, $\eta_p^2 = .48$. No other effects were significant, all Fs < 1. If the infants had not noticed the change in actor, they would have looked equally at the new-actor and old-actor events. Instead, the infants found the new-actor event novel, suggesting they were able to discriminate between the two actors. It is therefore unlikely that the infants in the same-group condition confused Topid-B for Topid-A.

General Discussion

[2] Buresh and Woodward (2007) tested 8 infants in their actor-discrimination condition.

The current study examined the origins of social-category based inductive inferences in infancy. Infants encountered two arbitrary social groups, Topids and Brinkos, and learned that a particular Topid preferred one of two foods. Infants later expected another Topid to prefer the same food and looked longer if she did not. However, infants had no expectations about whether members of different social groups (a Topid and a Brinko) would share preferences. Infants held similar expectations regardless of whether the actors identified their group membership with novel nouns or adjectives.

These findings expand our understanding of early social-category based reasoning in several ways. First, these findings add to recent evidence that infants can categorize individuals as members of a group, even if they themselves are not members of that group (e.g., Jin & Baillargeon, 2017; Liberman et al., 2016; Powell & Spelke, 2013; Rhodes et al., 2015). This growing body of work suggests that infants' understanding of social categories is not limited to a preference for familiar characteristics (e.g., a native accent) or a recognition of whether an individual belongs to their own group versus another group (i.e. ingroup vs. outgroup). Instead, these results suggest that infants can use cues to group membership to categorize individuals as members of entirely novel social groups with which they are not affiliated. They can then use membership in these novel groups to reason about how individuals will behave.

Second, this study provides the first empirical evidence that infants use social-category membership to make inductive inferences when other group members are not present. Only one agent was present in the test trial, and that agent did not see which food the other agent had selected during the familiarization trials. Thus, infants' responses in the test trial were not influenced by expectations that the agent would engage in imitation or be influenced by social pressures. Instead, infants' pattern of responses suggests that infants expected members of a social group to be similar

to one another and hence to share food preferences. Our results suggest that by 20 months, infants can use social-category membership to reason about the characteristics of an agent, independent of social pressures.

Our findings thus demonstrate that infants, like older children and adults, are capable of making inductive inferences about the properties of an individual based on social-category membership. The current findings also raise a number of interesting questions about the types of inductive inferences that infants make about members of a social group. One such question is whether the infants in our study were reasoning about shared *preferences* or shared *avoidance*. Although we have discussed our findings in terms of shared preferences, infants could have instead inferred that the Topid was avoiding the food she did not select and expected other Topids to avoid the same food. Since both shared preferences for and shared avoidance of specific foods exist across cultures (i.e. some cultural groups prefer pork products, whereas others prohibit consuming pork; e.g., Fischler, 1988; Shutts et al., 2013), it is possible that infants are able to reason about both of these properties.

Although possible, we think it is more likely that the infants in our study were reasoning about shared preferences. In the familiarization trials, Topid-A repeatedly selected the same food and emoted positively towards it each time. Prior research suggests infants view both consistent choice information and positive affect as signaling a preference for and desire to approach a given object (Baillargeon, Scott, & Bian, 2016; Phillips, Wellman, & Spelke, 2002). Unlike in Liberman et al.'s (2016) work, none of the agents in our study ever expressed dislike or disgust towards either food. Thus, the only basis infants would have for inferring that dislike or avoidance of the non-selected food was the fact that Topid-A consistently did *not* choose it. A recent study by Feiman and colleagues suggests that infants have difficulty attributing avoidance goals to agents

based on this type of selective reaching behavior: infants expected an agent who repeatedly chose object-A over other objects to choose it again, but they had no expectation that an agent who repeatedly chose other objects over object-A would avoid object-A in the future (Fieman, Carey, & Cushman, 2015). It therefore seems more likely that the infants in our study were reasoning about the Topids' shared preference for the food Topid-A selected than shared dislike or avoidance of the non-selected food. It remains an open question whether infants this age would use social-category membership to make inductive inferences about shared avoidance.

This raises a related, broader question concerning the types of inductive inferences infants make based on social-category membership. Older children use group membership to make inductive inferences about a variety of characteristics such as preferences for objects and activities, personality traits, behaviors, friendships, and beliefs (Birnbaum et al., 2010; Boseovski & Lee, 2006; Diesendruck & HaLevi, 2006; Martin et al., 1995; Shutts et al., 2013). Powell and Spelke's (2013) results suggest that infants consider group membership when reasoning about an individuals' choice of activity. Together with Liberman et al. (2016), our results suggest that infants also use social-category membership to make inferences about an agent's food preferences. However, Liberman et al. (2016) found that after seeing two agents interact positively, 14-month-olds held no expectations about whether the agents would express like or dislike towards the same objects (Liberman et al., 2016). Similarly, ongoing work in our lab suggests that when tested in a paradigm very similar to the one used here, 20-month-olds do not readily link personality traits, such as being helpful, to social-group membership: after viewing one member of a social group repeatedly either help or hinder another individual, 20-month-olds have no expectation about whether another member of that group will also help or hinder (Smith & Scott, 2017). This suggests that infants might make some types of social-category based inferences (e.g., activity, food

preference) more readily than others (e.g., object preferences, personality traits). Additional work is needed to determine the range of social-group based inferences that infants are able to make and the circumstances under which they do so.

Finally, the current study provides initial evidence that infants might use adjectives to identify social categories. Although the groups in our study were also marked by physical appearance, prior evidence suggests that appearance cues alone are not sufficient to support social categorization in 4-year-olds (Baron et al., 2014) or infants (Powell & Spelke, 2013). Furthermore, when no perceptual cues to group membership are provided, 17-month-old infants are able to use noun phrases to identify social groups (Jin & Baillargeon, 2017). Thus, it is unlikely that infants in the current study responded solely on the basis of a low-level perceptual cue, such as shared physical appearance. This would suggest that infants in the current study relied on the agents' appearance in conjunction with their verbal utterances (noun or adjective) to identify group membership, and that the nouns and adjectives were both effective at supporting group induction.

It is however possible that infants in the current study treated nouns and adjectives differently, but our sample size was too small to detect these differences. Within each combination of group condition and test event, only 9 infants heard adjectives and 9 heard nouns. Although possible, none of the main effects or interactions involving word condition approached significance and the effect sizes were quite small (all $\eta_p^2 < .013$). Thus, while we cannot rule out the possibility that a difference between nouns and adjectives would emerge with a sufficiently large sample, we think it more likely that infants treated the two as equally effective markers of group membership.

However, it remains unclear why nouns and adjectives were equally effective at supporting group induction in the current study. One possibility is that when they are applied to social

categories, infants use both nouns and adjectives to identify social categories with inductive potential. This would contrast with prior work that has found that infants use nouns but not adjectives to make inductive inferences about objects (e.g., Graham et al., 2004; Keates & Graham, 2008). Perhaps young infants have already encountered the use of adjectives as a marker of group membership in their environment (e.g., "She's British"), and have learned to apply adjectives differently when linked to social categories. An alternative possibility is that rather than treating nouns and adjectives as equivalent, infants in the current study interpreted the adjective phrase as a different type of group-membership marker. For instance, infants could have interpreted the actors saying the same adjective phrase as an affiliative behavior or engagement in a shared activity, such as in previous work by Liberman and colleagues (2016) and Powell and Spelke (2013), respectively. This element of shared action did not occur in previous studies involving objects (i.e., Graham et al., 2004; Keates & Graham, 2008) because objects are unable to engage in shared activity. If this is the case, then any kind of shared language phrase, or shared non-verbal action, might be equally effective as adjectives at supporting group induction. Thus, although our results suggest that adjectives can provide a cue to group membership, further work is needed to determine precisely how infants use adjectives to identify social groups.

In conclusion, the current study found that 20-month-old infants can use social-group membership to make inductive inferences about an individual's preferences, even when that individual is acting in the absence of its group members. Infants expected two individuals to share food preferences when the individuals belonged to the same social group, but infants had no expectations about whether members of two different social groups would share food preferences. Our results begin to shed light on the circumstances for which infants treat social group members as alike and provide further evidence that social-group reasoning has its roots in infancy.

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Figure Captions

Figure 1. Schematic depiction of the events shown in the group-induction trial for the same-group noun (left) and different-group noun (right) conditions. During the trial, the actors took turns identifying their social-group membership, beginning with the actor on the left and proceeding to the right. The procedure in the corresponding adjective conditions was identical except that the actors identified themselves by saying either "I am Topish" or "I am Brinkish."

Figure 2. Schematic depiction of the events shown in the familiarization trials for all conditions. Topid-A selected the same food in all three familiarization trials. Topid-A's food preference was counterbalanced across infants: half saw her choose the purple food three times, and the other half saw her choose the blue food three times.

Figure 3. Schematic depiction of the events shown in the test trial in the same-group condition. Infants in the different-group condition saw identical events except that the agent was dressed as a Brinko rather than a Topid.

Figure 4. Mean looking time (seconds) during the final phase of the test trials, separately by condition and event. Error bars represent standard errors and asterisks indicate a significant difference between trials within a condition ($p < .05$).