20-month-olds Use Social-Group Membership to Make Inductive Inferences

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Abstract

Previous research suggests that preschool children expect members of social groups to share stable, inherent characteristics (e.g., Waxman, 2013). Here we explored the origins of these social-group based inferences by examining whether infants generalize food preferences across members of an arbitrary social group. Experiment 1 demonstrated that infants expected two individuals to share food preferences when they belonged to the same social group, but not when they belonged to two different social groups. Experiment 2 replicated and extended these findings to social groups that were labeled with adjectives instead of nouns. These results suggest that by 20 months of age, infants use social-group membership to make inductive inferences about the behavior of group members.

Keywords: social groups; inductive inference; psychological reasoning; social cognition

Introduction

Categorization is vital to human cognition. Category representations provide an efficient way of organizing our knowledge about the world, and they enable generalization of prior knowledge to novel entities and situations (Gelman, 1988; Medin, ojalehto, Waxman, & Bang, 2015). Upon identifying that a novel entity belongs to a familiar category (e.g., *dog*), one can infer that it likely possesses common properties of that category (e.g., it is alive, wags its tail, etc.). Categories also aid in reasoning about kinds of people: Adults tend to assume social categories (e.g., doctors, women) capture fundamental, inherent similarities amongst collections of individuals and thus use prior knowledge about a social category to make inductive inferences about the physical, psychological, and behavioral properties of novel group members (e.g., Agerström, Björklund, Carlsson, & Rooth, 2012).

The tendency to use social-group membership to make inductive inferences about category members is well established by the preschool years. (e.g., Bigler, Jones, & Lobliner, 1997; Birnbaum, Deeb, Segall, Ben-Eliyahu, & Diesendruck, 2010; Diesendruck & HaLevi, 2006; Waxman, 2013). For example, 5-year-old children expect that members of the same social category will prefer the same activities (Diesendruck & HaLevi, 2006) and preschoolers expect that members of the same, but not the opposite, sex will prefer the same toys (Martin, Eisenbud, & Rose, 1995).

When and how does this tendency to make social-group based inferences emerge? As early as 3 months, infants notice visual and auditory features that are associated with social-group membership (e.g., Bar-Haim, Ziv, Lamy, & Hodes, 2006; Howard, Henderson, Carrazza, & Woodward, 2015; Shutts, Kinzler, McKee, & Spelke, 2009). Evidence for this comes primarily from tasks that assess whether infants demonstrate preferences for individuals who are similar to themselves. For example, by 3 months infants living in primarily own-race environments prefer to attend to own-race over other-race faces (Bar-Haim et al., 2006). By 19 months, infants prefer to accept toys and foods endorsed by a speaker of their native language over a speaker of a foreign language (Kinzler, Dupoux, & Spelke, 2007; Shutts et al., 2009) and are more likely to imitate actions produced by a native-language speaker (Howard et al., 2015). By 11.5 months, infants also attend to food preferences and clothing as potential markers of group membership (Mahajan & Wynn, 2012).

There is also some evidence that infants spontaneously categorize individuals into social groups instead of merely detecting features correlated with group membership (Powell & Spelke, 2013; Liberman, Kinzler, & Woodward, 2014; Liberman, Woodward, Sullivan, & Kinzler, 2016; Rhodes, Hetherington, Brink, & Wellman, 2015). These findings come from "third-party" tasks in which the infant is not a member of the groups in question. For example, Liberman et al. (2016) examined whether 14-month-old infants expect individuals who affiliate to share food preferences. In a violation-of-expectation task, infants were first introduced to two actors who either affiliated with one another by smiling and saying "Hi", or disengaged from one another by turning away, crossing their arms, and saying "Hmph." Next, Actor-2 watched as Actor-1 ate one of two foods and emoted positively. In the test trial, Actor-2 ate the same food and emoted negatively, actively disagreeing with Actor-1's preference. Infants who saw the actors affiliate expected them to prefer the same food, and looked longer if they disagreed. In contrast, infants did not expect actors that had previously disengaged to share food preferences. Together with the results of several additional conditions, these findings suggested that infants can use social relationships to predict and interpret the behavior of agents.

However, it remains unclear whether infants expect that members of a social category will share stable, inherent characteristics. This is because in prior studies, such as the one just described, the target character always acted in the presence of its group members. Infants' responses may therefore have reflected an expectation that the target character would conform to social pressures or imitate group members, rather than expectations about the inherent properties and tendencies of the individual. The present research thus asked whether infants use social group membership to make inductive inferences about the properties of an individual, even when that individual is acting in the absence of other group members.

To address this question, we examined whether 20-month-old infants expected members of a social group to share food preferences. Several decades of research suggest that by this age, infants attribute preferences to agents (e.g., Woodward, 1998). Moreover, by 18 months infants assume that an agent's preference is specific to that individual unless given indication otherwise (Egyed, Király, & Gergely, 2013). This allowed us to test whether social-group membership overrides this default assumption. We focused specifically on food preferences because foods are culturally relevant and thus likely to be shared amongst members of a social group (Cashdan, 1998; Rozin & Siegal, 2003).

Infants were tested in a violation-of-expectation task involving arbitrary social groups, Topids and Brinkos. Arbitrary social groups were used in order to ensure infants had equal amounts of experience with the social groups being tested. The groups were identified using both shared appearance and noun labels because previous research suggests that infants might not form social categories based on physical appearance alone (e.g., Powell & Spelke, 2013). In the familiarization trials, infants saw a member of one of the social groups (a Topid) demonstrate a preference for one of two novel foods. In the test trial, infants saw a single agent from either the same group (another Topid) or a different group (a Brinko) choose between the two foods. If infants use social group membership to make inductive inferences about food preferences, then they should expect members of the same social group to pick the same foods, and should look longer if the Topid picks a different food instead. In contrast, infants should not use the preferences of one social group to make inferences about the preferences of an individual from a different social group. Infants should thus have no expectations about what the Brinko should choose and look equally regardless of whether she chooses the same or a different food.

Experiment 1

Method

Participants 36 healthy term infants participated (18 female; ages 18 months, 10 days to 21 months, 18 days, M = 20 months, 8 days). Another 12 infants were tested but excluded because they were fussy (8), because of parental interference (2), or because their test looking time was over 2.5 SD away from the mean of their condition (2). Half the infants were randomly assigned to the same-group condition (M = 20 months, 16 days) and half to the different-group condition (M = 20 months, 0 days).

Stimuli Stimuli consisted of digitized high-definition video recordings of actors performing a series of actions. All infants saw four familiarization trials and one test trial. A separate video was played for each trial. Each trial consisted of an 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.

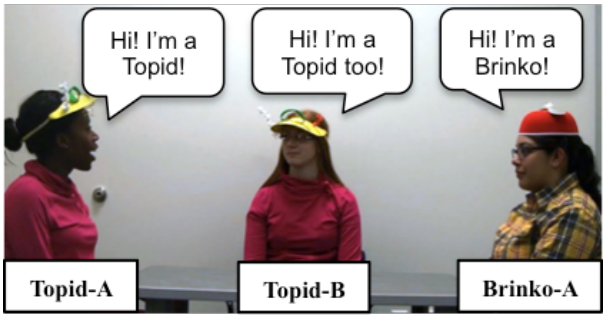

Figure 1: Familiarization trial 1 of the same-group condition of Experiment 1.

Same-group familiarization trials At the start of the first familiarization trial, three female actors sat around a table (Figure 1). Two of the actors (Topid-A, Topid-B) wore bright pink turtlenecks and decorated yellow visors while the third (Brinko-A) wore a plaid shirt and a propeller hat.

All actors began the trial with their heads down. During the 10-s initial phase of the trial, the actors looked at one another and labeled themselves: Topid-A said "Hi, I'm a Topid," Topid-B said, "Hi, I'm a Topid too," and Brinko-A said, "Hi, I'm a Brinko." As each actor labeled herself, she looked back and forth between the other two actors. When not labeling themselves, the actors looked at the speaking actor as she spoke. After all actors had labeled themselves, the actors looked down and paused. The infants viewed this paused scene until the trial ended (see Apparatus and procedure section for trial-ending criteria).

The infants then received three familiarization trials in which Topid-A demonstrated her preference for one of two foods. On each trial, Topid-A sat behind a table. In front of her were two white plates (18 cm in diameter) placed 25 cm apart. The plate on the right held purple pasta and the plate on the left held blue cereal. During the 10-s initial phase of the trial, Topid-A selected one of the foods (counterbalanced across infants) and ate it while saying, "Mmm!" She then looked down at the center of the table between the two plates and paused until the trial ended. Topid-A selected the same food on all three trials, demonstrating that she preferred it to the other food.

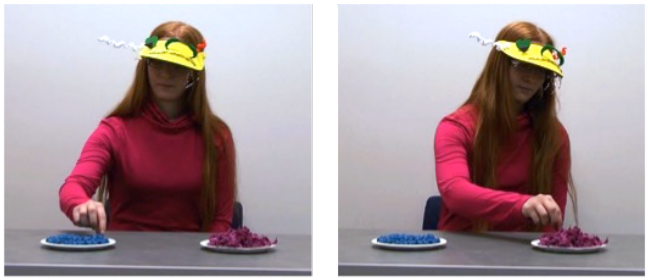

Figure 2: Test events shown in the same-group condition of Experiment 1.

Same-group test trials The infants received either a same-food or different-food test trial (Figure 2). For ease of description, the test trials are described from the perspective of the infants who saw Topid-A choose blue cereal in the familiarization trials.

At the start of the trial, none of the actors were present. The plates of blue cereal and purple pasta again sat on the table. During the 10-s initial phase of the trial, Topid-B entered from the left, sat down, and then selected a piece of blue cereal (same-food event) or purple pasta (different-food event), raised it to her mouth, and ate the food. After eating the food, she proceeded to say, "Mmm!" and smile, displaying positive affect and indicating she enjoyed eating the food. She then looked down at the center of the table between the two foods and paused until the trial ended.

Figure 3: Familiarization trial 1 of the different-group condition of Experiment 1

Different-group familiarization and test trials The procedure for the different-group condition was identical to that of the same-group condition with one exception: the actor who played Topid-B in the same-group condition now played Brinko-B throughout the experiment. In the first familiarization trial, she wore the same costume as Brinko-A and labeled herself as a Brinko (Figure 3). In familiarization trials 2-4, infants saw Topid-A establish her food preference, as in the same-group condition. In the test trial, the actor wore a Brinko costume, but her actions were otherwise identical to those she performed in the same-group condition. The infants in both conditions thus saw the exact same actor in the test trial. All that differed was which costume she wore and whether she had previously labeled herself as a Brinko or a Topid. Any observed differences in looking times across conditions could therefore not be due to a preference for a particular individual.

Apparatus and procedure The 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 at the base of the television (centered, 89 cm above the floor) recorded the infant's face during the experiment. Parents were instructed to close their eyes or look down to avoid biasing their infant's responses.

The television was connected to a Macintosh computer located to the left of the infant behind a sound-dampening room divider. This computer controlled the presentation of the experimental stimuli using custom software written in Python (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). The software also controlled the duration of each trial. 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 fixed-duration and infant-controlled portions of each trial; looking times during the infant-controlled portion of the trial 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 back 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 on the television screen. The infants first viewed four familiarization trials appropriate for their condition. Each familiarization 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.

Finally, the infants viewed the test trial that was appropriate for their condition; half the infants in each condition saw the same-food trial and half saw the different-food trial. This trial ended when the infant either (1) looked away for .5 consecutive seconds after having looked for at least 4 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 events with trial duration contingent on the infant's attention, online coding was conducted by the experimenter (blind to condition and test trial), as described above. All infants were then coded offline from silent video by a trained coder who was naïve to the condition and test trial that the infant received; the looking times resulting from this coding were used in all analyses. For each trial, the coder indicated the infant's direction of gaze (at the stimuli or away) for each frame of the video. Another trained coder who was naïve to the infant's condition and test trial coded all sessions, and these two coder's agreed on the child's direction of gaze for 96% of video frames. Trials in which agreement was less than 90% (15/180) were resolved by a third naïve coder.

The infants were highly attentive during the initial phase of the familiarization trials: averaged across the four familiarization trials, the infants attended for 96% of the initial phase. The infants were also highly attentive during the initial phase of the test trial, attending for 97% of the initial phase.

Preliminary analyses of the test data indicated no

significant interactions of condition and event with sex or which food Topid-A preferred (blue vs. purple), all Fs < 1.55, all ps > .22. The data were therefore collapsed across these factors in subsequent analyses. In order to control for baseline differences in attention, all analyses were run with average looking time during the final phases of the familiarization trials as a covariate.

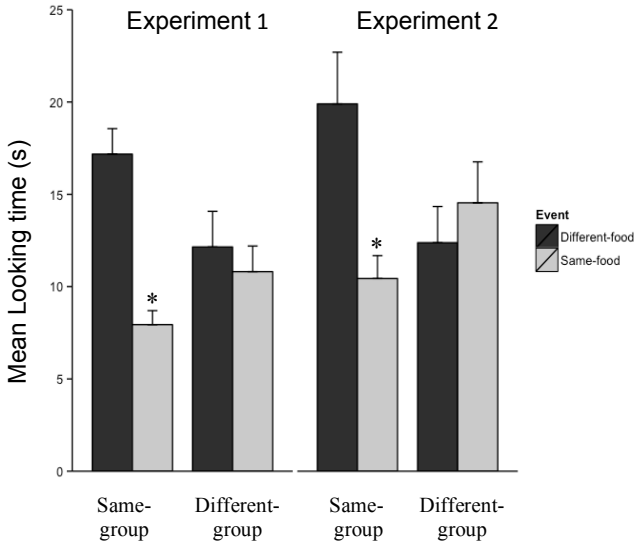

Figure 4: Mean looking time (sec) of the infants during the test trial of Experiments 1 and 2 as a function of condition and event. Error bars represent standard errors, and asterisks indicate a significant difference between events with a condition ($p < .05$).

Results and Discussion

The infants' looking times during the test trial (see Figure 4) were analyzed using an analysis of covariance (ANCOVA) with condition (same-group, different-group) and event (same-food, different-food) as between-subjects factors. There was a main effect of event, $F(1, 31) = 14.20$, $p = .001$, $\eta_p^2 = .31$, indicating that the infants who saw the different-food event looked longer than those who saw the same-food event in the test trial. However, this effect was qualified by a significant interaction of condition and event, $F(1, 31) = 9.03$, $p = .005$, $\eta_p^2 = .23$. There was no main effect of condition, $F < 1$. Planned simple effect comparisons revealed that in the same-group condition, the infants who received the different-food event ($M = 17.18$, $SD = 4.14$) looked reliably longer than those who received the same-food event ($M = 7.94$, $SD = 2.29$), $F(1, 31) = 23.00$, $p < .001$, Cohen's $d = 2.76$. In the different-group condition, the infants looked about equally whether they received the same-food event ($M = 10.81$, $SD = 4.16$) or the different-food event ($M = 12.15$, $SD = 5.80$), $F < 1$.

As predicted, the infants in the same-group condition looked reliably longer if they received the different-food event than if they received the same-food event. This suggests that the infants expected members of the same social group to share food preferences, and they looked longer if members of the same social group had different food preferences. In contrast, the infants in the different-group condition looked equally regardless of whether members of different social groups picked the same or different foods.

However, a possible alternative explanation of these results is that when Topid-A and Topid-B wore the same outfit, the infants were unable to discriminate between them. 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 were tested in an actor-discrimination condition (procedure adapted from Buresh & Woodward, 2007). Infants first saw the same familiarization trials as in the same-group 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 chosen during the familiarization trials (order of test events counterbalanced across infants). 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 (old-actor first, new-actor first) as a between-subjects factor. The analysis yielded a main effect of event, $F(1, 10) = 9.08$, $p = .013$, $\eta_p^2 = .48$, indicating that the infants looked longer at the new-actor test event ($M = 11.44$, $SD = 4.58$) than the old-actor event ($M = 7.34$ S$D = 2.24$). No other effects were significant, all Fs < 1. If the infants had not noticed the change in actor, they would have looked equally to the new-actor and old-actor events. However, the infants found the new-actor event novel, suggesting that infants were able to discriminate between the two actors.

Together, these findings provide additional evidence that infants can reason about members of a group that they themselves do not belong to (Powell & Spelke, 2013; Liberman et al., 2016) and add to these prior findings by demonstrating that infants expect members of social groups to share inherent properties.

Experiment 2

Experiment 2 had two goals. The primary goal was to replicate the positive findings from the same-group condition in Experiment 1. Our secondary goal was to explore whether the noun labels in Experiment 1 were necessary for children to establish social groups with inductive potential. To investigate this question, infants were assigned to an adjective condition that was identical to the same-group condition of Experiment 1 except that the actors labeled themselves with adjectives instead of nouns. If infants require noun labels to identify social groups with inductive potential, then when the social groups are labeled with adjectives, infants will no longer generalize preferences across members of a social group. If, however,

infants can use adjectives to identify social groups with inductive potential, then infants will expect members of the same social category to pick the same foods, replicating the results of the same-group condition of Experiment 1.

Method

Participants 30 healthy term infants participated (16 female; ages 18 months, 3 days to 21 months, 29 days, *M* = 19 months, 16 days). Another 5 infants were tested but excluded because they were fussy (3), or because of parental interference (2). Eighteen infants were randomly assigned to the same-group condition (*M* = 19 months, 27 days) and 12 to the different-group condition (*M* = 19 months, 0 day).

Stimuli, Apparatus, and Procedure The stimuli, apparatus, and procedure were identical to Experiment 1 except that in the first familiarization trial the actors labeled themselves with adjectives instead of nouns (e.g., "Hi! I'm Topish.").

Coding and analysis As in Experiment 1, all infants were coded offline by a coder naïve to the condition and test trial that the infant received. An additional naïve coder coded all participants; agreement between the two coders was 97%. Trials in which agreement was less than 90% (4/150) were resolved by a third naïve coder

Infants were highly attentive during the initial phase of all familiarization trials; averaged across all four trials, infants attended for 98% of the initial phase. Infants were also highly attentive during the initial phase of the test trial, attending for 98% of the initial phase.

Preliminary analyses of the test data indicated no significant interactions of condition and event with sex, or which food Topid-A preferred (blue vs. purple), all *F*s < 1. The data were therefore collapsed across these factors in subsequent analyses.

Results and Discussion

Infants' looking times during the test trial were analyzed using an ANCOVA with condition (same-group, different-group) and event (same-food, different-food) as between-subjects factors, and infants' average looking times during the final phases of the familiarization trials as a covariate. Results revealed a significant interaction between condition and event $F(1, 25) = 4.75$, $p = .039$, $\eta_p^2 = .16$. There were no main effects of event or condition, both *F*s < 1. Planned simple effect comparisons revealed that in the same-group condition, the infants who received the different-food event ($M = 19.90$, $SD = 8.40$) looked reliably longer than those who received the same-food event ($M = 10.44$, $SD = 3.73$), $F(1, 25) = 8.59$, $p = .007$, $d = 1.46$. In the different-group condition, the infants looked about equally whether they received the same-food event ($M = 14.54$, $SD = 5.43$) or the different-food event ($M = 12.38$, $SD = 4.79$), $F < 1$. These results suggest that, similar to the results of Experiment 1, infants in Experiment 2 expected members of a social group to share food preferences and looked longer when members of the same social group had different preferences. In contrast, infants had no expectation about whether members of different social groups would share food preferences.

To investigate whether infants' looking time patterns were similar across experiments, infants' looking times to the test trial were analyzed using an ANCOVA with Experiment (1, 2), condition (same-group, different-group), and event (same-food, different-food) as between-subjects factors, and infants' average looking times during the final phases of the familiarization trials as a covariate. Results revealed a main effect of event, $F(1, 57) = 12.33$, $p < .001$, $\eta_p^2 = .18$. This effect was qualified by a significant interaction of condition and event, $F(1,57) = 13.93$, $p = < .001$, $\eta_p^2 = .20$. No other effects were significant, all *F*s < 2.3, *p*s > .14. The absence of any main effects or interactions involving Experiment suggests that regardless of whether the social groups were labeled with nouns or adjectives, infants expected members of the same social group to prefer the same foods.

General Discussion

By preschool, children expect members of a social group to share characteristics and thus use social-group membership to draw inductive inferences about the properties of novel individuals. The current studies examined the origins of this social-group based reasoning in infancy. Specifically, we examined whether infants expect members of a social group to share preferences. Infants were introduced to members of 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 (i.e. a Topid and a Brinko) would share preferences. Infants held similar expectations regardless of whether the group members labeled themselves with nouns (Topid, Brinko) or adjectives (Topish, Brinkish).

These findings expand our understanding of infants' social-group based reasoning in several key ways. First, these studies provide additional evidence that infants can categorize individuals as members of a social group, even if they themselves are not members of that group (e.g., Liberman et al., 2016; Powell & Spelke, 2013). Second, these studies expand on prior work by providing the first empirical evidence that infants as young as 20 months use social-group membership to make inductive inferences about the likely behavior of group members, even when other group members are not present. In our experiments, 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' expectations regarding the agent's behavior in the test trial are unlikely to have been based on social pressures or imitation. Even without the presence of other group members, infants expected members of a social group to share stable, inherent properties.

Together, the current studies begin to shed light on the

circumstances under which infants treat social group members as alike, and the age at which these expectations emerge. Future studies should further explore the precise nature of infants' social-group based inferences. For instance, we have discussed our results in terms of shared preferences: when Topid-A selects blue cereal over purple pasta, infants interpret this as signaling that Topids prefer blue cereal and hence expect another Topid to share this preference and also select blue cereal. However, perhaps infants were instead reasoning about shared *avoidance* of the food that Topid-A did not select – Topids do not eat purple pasta – and hence expected another Topid to avoid that food as well. Both shared preferences for and shared avoidance of specific foods exist across cultures (i.e. some cultural groups have a strong preferences for pork products, whereas other groups prohibit consuming pork). Future research should examine whether infants expect group members to like the same foods, avoid the same foods, or both. Additionally, future research should examine whether infants were reasoning specifically about *foods*, or whether infants could also have been reasoning about other features of the event (i.e. reaching for a particular color). Such studies will help clarify the characteristics that infants expect social-group members to share.

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