

# Third-Party Preferences for Imitators in Preverbal Infants

Lindsey J. Powell<sup>1</sup> and Elizabeth S. Spelke<sup>2</sup> 

<sup>1</sup>Department of Brain and Cognitive Sciences, Massachusetts Institute of Technology

<sup>2</sup>Department of Psychology, Harvard University

**Keywords:** imitation, social cognition, infancy

---

## ABSTRACT

Participants in social interactions often imitate one another, thereby enhancing their affiliation. Here we probe the nature and early development of imitation-based affiliation through studies of infants' preferences for animated characters who imitate, or are imitated by, other characters. Four experiments provide evidence that preverbal infants preferentially attend to and approach individuals who imitate others. This preferential engagement is elicited by the elements of mimicry in simple acts of helping. It does not, however, extend to the targets of imitation in these interactions. This set of findings suggests infants' imitation-based preferences are not well explained by homophily, prestige, or familiarity. We propose instead that infants perceive imitation as an indicator of valuable attributes in a potential social partner, including the capacity and motivation for social attention and coordinated action.

---

During social interaction humans mimic one another's behavior. Such social imitation is ubiquitous: it occurs among friends, strangers, and parents engaging with their infants (Chartrand & Lakin, 2013; Kokkinaki & Kugiumutzakis, 2000; LaFrance, 1979). It improves the quality of social interactions, leading people to like their partners more and treat them better (Chartrand & Bargh, 1999; van Baaren, Holland, Kawakami, & van Knippenberg, 2004; van Baaren, Holland, Steenaert, & van Knippenberg, 2003). Despite the importance of social imitation for interpersonal interaction, however, its origins and nature are obscure.

Infants imitate both actions and sounds by the end of the first year (e.g., Barr, Dowden, & Hayne, 1996; Jones, 2007; Meltzoff, 1988), but their motives in performing these actions, and their interpretation of imitative acts, are not clear. A few studies suggest that toddlers in the second year appreciate the social value of imitation and respond positively to those who imitate them (Agnetta & Rochat, 2004; Carpenter, Uebel, & Tomasello, 2013; Meltzoff, 1990), but little evidence suggests whether observed acts of imitation carry social meaning for younger infants.

A recent series of experiments addressed this question by asking if 4- and 5-month-old infants who observe imitative interactions as third parties expect the interaction partners to affiliate with one another (Powell & Spelke, 2018a). First, infants observed animated events depicting one character engaging in imitative and nonimitative interactions with two separate social parties. Then, across several experiments, a violation of expectancy looking time method was used to test (1) if infants expected the targets of imitative and nonimitative responses to approach partners who had imitated them, and (2) if infants expected responding characters to approach targets they had or had not imitated. Looking times indicated that infants did expect responding characters to approach and affiliate with the social partners they had imitated,

**Citation:** Powell, L. J., & Spelke, E. S. (2018). Third-Party Preferences for Imitators in Preverbal Infants. *Open Mind: Discoveries in Cognitive Science*, 1(4), 183–193. [https://doi.org/10.1162/opmi\\_a\\_00018](https://doi.org/10.1162/opmi_a_00018)

**DOI:**  
[https://doi.org/10.1162/opmi\\_a\\_00018](https://doi.org/10.1162/opmi_a_00018)

**Supplemental Materials:**  
[https://doi.org/10.1162/opmi\\_a\\_00018](https://doi.org/10.1162/opmi_a_00018)

**Received:** 30 September 2017  
**Accepted:** 5 July 2018

**Competing Interests:** The authors declare no competing interests.

**Corresponding Author:**  
Lindsey J. Powell  
[ljpowell@mit.edu](mailto:ljpowell@mit.edu)

---

**Copyright:** © 2018  
Massachusetts Institute of Technology  
Published under a Creative Commons  
Attribution 4.0 International  
(CC BY 4.0) license



though the strength of this expectation was graded, yielding reversals in looking preferences as display complexity and participant age varied, and no looking preferences under conditions of intermediate complexity. In contrast, infants' looking patterns provided no evidence of expectations that target characters would approach those who imitated them over those who did not.

These findings provide evidence that imitation carries social meaning for young infants, but do not reveal what that meaning is. Do infants expect imitators to approach their targets because they view them as similar to one another? Because they view the targets as more prestigious? As more desirable? Or do infants expect others to approach the individuals that they imitate because both imitation and approach are indicative of the imitator's prosocial nature or orientation toward the target? To approach these questions, here we ask if infants themselves prefer individuals who imitate, or are imitated by, others. For most of the infants we tested, these experiments began when the above studies ended: after infants viewed two characters interact imitatively or nonimitatively with a third character, and then either approach or be approached by that character (Powell & Spelke, 2018a, Experiment 4). Following these displays, we tested infants' relative preference between the imitating and nonimitating characters. With these studies, we seek to better characterize the social value of imitation for infants.

Four hypotheses make largely nonoverlapping predictions regarding infants' potential preferences for imitators over nonimitators and for targets of imitation over nontargets, following third-party observations of imitative interactions. According to the hypothesis of homophily—a liking for similar others (Byrne & Griffitt, 1966; Fawcett & Markson, 2010; Mahajan & Wynn, 2012; Neimeyer & Mitchell, 1988)—participants in social interactions interpret imitators' reproduction of their actions as evidence of similarity to themselves (Haun & Over, 2015; Lakin, Jefferis, Cheng, & Chartrand, 2003). This hypothesis predicts that third-party observation of imitation will not affect the observer's social preferences: observations of imitation should only increase infants' perception of the imitator's similarity to its target, not to the infant.

A second hypothesis is based on the finding that familiarity engenders preferences at all ages (Cooke, 2007; Peery & Peery, 1986; Zajonc, 1968), including infancy (e.g., bar-Haim, Ziv, Lamy, & Hodes, 2006; Kinzler, Dupoux, & Spelke, 2007; Mehr, Song, & Spelke, 2016). In the context of imitative and nonimitative interactions, infants could develop a preference for both the imitator and the target on the basis of greater accumulated familiarity with the imitated behavior, which would be performed more frequently.

Third, infants may view imitation primarily as an indicator of the prestige, or social value, of the target of imitation. Thus they may prefer such targets to those who are not targeted by acts of imitation, as do older children and adults (Chudek, Heller, Birch, & Henrich, 2012; Henrich & Gil-White, 2001; Over & Carpenter, 2015), while showing no preference for imitators over nonimitators.

Finally, infants' preferences may be elicited by the distinguishing characteristic of imitation: alignment with the behavior of others. Such alignment may provide evidence of the imitator's prosocial capacities and motivation toward social engagement, while providing no evidence regarding the prosocial capacities or motivation of the target. Thus, infants who observe imitative interactions may prefer imitators to nonimitators, but not targets to nontargets.

Experiments 1 and 2 begin testing these predictions by assessing 4.5-month-old infants' preferential looking to two characters who each respond to a third character's action, one

by imitating the action and the other by performing a contrasting action. Experiment 3 tests infants' relative preference between two characters who act in turn, one receiving an imitative response from a third character and the other receiving a contrasting response. Finally, Experiment 4 builds on positive evidence of preferential attention to imitators over nonimitators from Experiments 1 and 2 by testing whether 12.5-month-old infants preferentially reach for characters who imitate their social partners. In all experiments, interactions between characters were presented using animated displays run by display-blind experimenters, allowing us to assess infants' preferences using consistent events and unbiased experimenters.

## EXPERIMENT 1

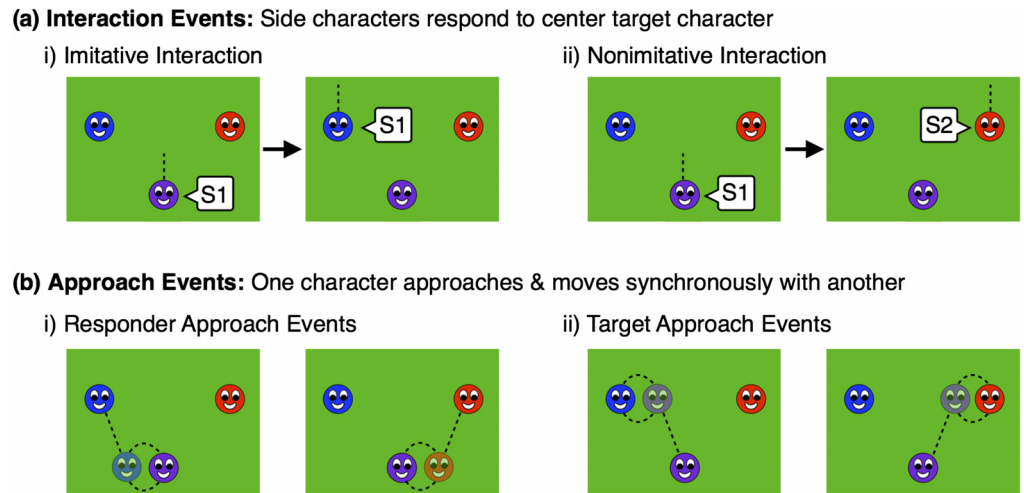
### Methods

We recruited 48 4- to 5.5-month-old infant participants from the greater Boston area. Forty of these infants were tested in conjunction with participation in Experiment 4 of Powell & Spelke (2018a), which evaluated infants' expectation of approach between imitators and targets. The main analyses of the current experiment did not involve the approach events, but rather tested infants' relative preference for imitating and nonimitating characters during a subsequently conducted preferential looking test. (Looking times to approach events were examined only to rule out potential influence on preferential looking; see the Supplemental Materials [Powell & Spelke, 2018b].) As a result of this difference in analytical focus, the two experiments had small differences in inclusion criteria. The eight nonoverlapping infants in the current sample were either recruited to replace participants from the previous experiment who did not meet the inclusion criterion for this experiment of looking to each character during the preference test for a minimum of 1 s or retained for this experiment but replaced in the approach experiment due to inattentiveness during approach events. These infants completed the same full procedure as the 40 infants that overlapped with Powell and Spelke (2018a). For details on these two sets of subjects, as well as subject demographics, inclusion criteria, and informed consent, see the Supplemental Materials (Powell & Spelke, 2018b).

The experiment consisted of three phases. In the first phase, infants viewed three animated characters engaging in pairwise interactions. Each interaction began with the central character (the *target*) jumping three times, making the same sound at the start of each jump. Then one of the side characters responded by jumping and making either the same or a different sound. Across eight events, the two side characters responded in alternation, one producing the same sound as the target (the *imitator*) and one producing a different sound (the *nonimitator*; Figure 1a; Movie S1 [Powell & Spelke, 2018b]).

In the next phase, infants saw approach events in which one character moved toward another, and then the two characters moved synchronously around a circular path (Figure 1b; Movie S1 [Powell & Spelke, 2018b]). After completing this path, the characters remained motionless on the screen while a display-blind coder tracked looking to the display. This infant-controlled pause ended after 60 s of cumulative looking or 2 s of consecutive looking away. Half of the participants saw *responder approach* events, in which the imitator and nonimitator alternately approached the target, and half saw *target approach* events, in which the target alternately approached the imitator and nonimitator (see the Supplemental Materials [Powell & Spelke, 2018b] and Powell & Spelke, 2018a, for use of these events to test infants' inferences of affiliation between imitators and targets).

Finally, we tested infants' relative preference for the imitator and nonimitator. A display-blind experimenter held a pair of disc-shaped objects with the same appearance as the imitator

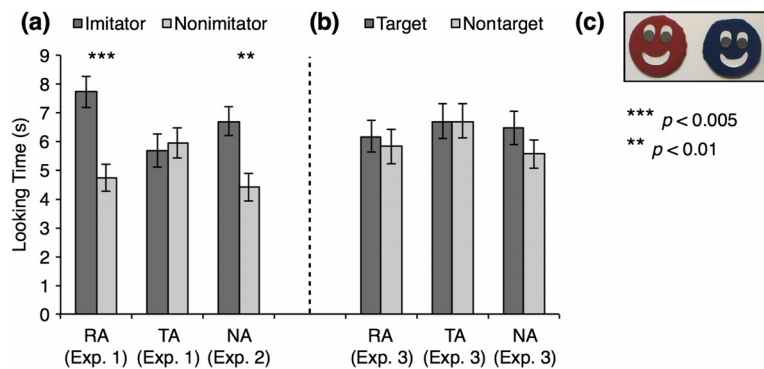


**Figure 1.** Illustrations of events from Experiments 1 and 2.

and nonimitator (Figure 2c) ~40 cm apart, centered in front of the infant but beyond reaching distance, for 20 s. Offline, condition-blind coders determined how much time infants spent looking at each character. We compared these looking times using a repeated-measures ANOVA, including interaction order (imitation first or second), approach type (responder or target), imitator identity (right- or left-side character), and imitated sound (high or low) as between-subjects factors. Looking times to imitative and nonimitative interaction events and congruent and incongruent approaches were compared similarly. (For additional procedural details and reliability coding, see the Supplemental Materials [Powell & Spelke, 2018b].)

**Results and Discussion**

Infants spent more time looking at nonimitative (11.07 s) than imitative interactions [10.67 s;  $F(1, 32) = 4.70, p < .05$ ], though infants were highly attentive to all interactions (maximum looking = 12 s). The small participant substitution did not change the finding from Powell and Spelke (2018a) that infants in both approach conditions looked equally at the two approach events (see the Supplemental Materials [Powell & Spelke, 2018b]).



**Figure 2.** Preferential looking results. (a) Looking times to the imitator and nonimitator (Experiments 1 & 2), and (b) looking times to the target and nontarget of imitation (Experiment 3), divided by the paired approach events (RA = Responder Approach; TA = Target Approach; NA = No Approach condition). Error bars represent standard error of the mean. (c) Physical characters presented during preference test.

In the critical, final preference test, infants looked longer to the imitator ( $M = 6.71$  s) than the nonimitator [ $M = 5.34$  s,  $F(1, 32) = 4.31$ ,  $p < .05$ ]. Preferential looking also interacted significantly with approach type [ $F(1, 32) = 6.37$ ,  $p < .05$ ]. Infants who saw responder approach events subsequently looked longer at the imitator (7.73 s) than the nonimitator [4.74 s;  $t(23) = 3.68$ ,  $p < .005$ ] during the preference test, while infants who saw target approach events showed no looking preference between the imitator (5.69 s) and the nonimitator [5.94 s;  $t(23) = 0.28$ ,  $p > .7$ ; Figure 2a].

Although we did not predict that the approach events would influence infants' preferential attention to the imitator and nonimitator, post hoc consideration suggests two potential origins of this effect. First, the responder approach events may be necessary to elicit an imitator preference. Infants may, for instance, prefer to attend to characters whose social behavior is consistent over time, that is, who respond to a social partner by both imitating and approaching him. Alternatively, the target approach events may have interfered with a preference for imitators, established in the interaction phase. Infants may prefer imitators over nonimitators, but that preference may be attenuated or erased if both are approached by the character who initiated the interactions, thereby signaling that both responding characters are valued. Experiment 2 distinguished these possibilities.

## **EXPERIMENT 2**

Experiment 2 tested infants' preference for imitators over nonimitators in the absence of any approach events.

### **Methods**

We recruited 24 novel 4- to 5.5-month-old participants. The interaction events and preferential looking test were identical to those of Experiment 1, except that each pair of interactions was followed by an infant-controlled pause during which the characters remained motionless onscreen (see the Supplemental Materials [Powell & Spelke, 2018b]). No approach events were presented.

### **Results and Discussion**

During familiarization, infants looked equally at the imitative (10.68 s) and nonimitative interactions [10.90 s;  $F(1, 16) = 0.96$ ,  $p > .3$ ]. Thus, the increased attention to nonimitative interactions found in Experiment 1 was not replicated in this study. During the subsequent preference test, infants spent significantly more time looking at the imitator (6.70 s) than the nonimitator [4.40 s;  $F(1, 16) = 9.35$ ,  $p < .01$ ; Figure 2a; for comparison with Experiment 1, see the Supplemental Materials (Powell & Spelke, 2018b)]. The approach events therefore were not necessary to produce preferential attention to the imitator. Instead, the target approach events evidently weakened infants' preference for the imitator, either by increasing the social value of both responding characters or by drawing infants' attention away from the responders and toward the target.

## **EXPERIMENT 3**

The preferential attention to imitators observed in Experiments 1 and 2 is consistent with the hypothesis that infants prefer individuals who imitate their social partners, perhaps because such alignment reflects the imitator's prosocial capacities or motivations. However, alternative explanations remain. Infants may have preferred the imitator because the sound it made occurred

more frequently and therefore became more familiar than the sound made by the nonimitator. Although homophily alone cannot explain infants' preference, as the infants themselves did not (and, indeed, cannot) produce the imitated sounds, perhaps infants prefer imitators and targets with homophilous relationships to one another. Moreover, apart from any preference for the imitator, infants may also perceive the targets of imitation as prestigious or socially valued individuals. All of these hypotheses predict that if we reverse the roles of the characters in the interactions from Experiments 1 and 2, such that the side characters are either imitated by the central character or not, then infants will prefer the character who is the target of imitation to the nontarget. Experiment 3 was undertaken to test this prediction.

**Methods**

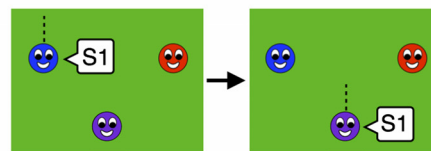
Seventy-two 4- to 5.5-month-old infants participated. Forty infants were tested in conjunction with their participation in Experiment 4 of Powell and Spelke (2018a; see the Supplemental Materials [Powell & Spelke, 2018b] for details on this joint participation, and for a comparison of looking times to approach events in the two overlapping samples). The interaction events were identical to those of Experiments 1 and 2, except that the side characters now jumped and vocalized first, and the central character responded to each of them, imitating one (the *target of imitation*) and not the other (the *nontarget*; Figure 3a; Movie S2; see details in the Supplemental Materials [Powell & Spelke, 2018b]). Twenty-four infants participated in each of three conditions that paired these new interaction events with the same approach events used in Experiments 1 and 2 (Figure 3b): events in which the center character alternately approached the side characters (now *responder approach* events, given the reversed interaction roles), events in which the side characters alternately approached the center character (now *target approach* events), or no approach events at all. The preference test remained unchanged.

**Results and Discussion**

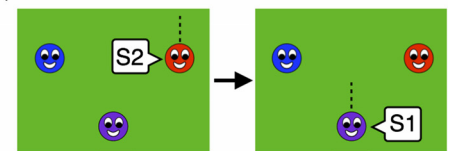
Infants looked equally to the imitative ( $M = 10.98\text{ s}$ ) and nonimitative interactions [ $M = 10.76\text{ s}$ ;  $F(1, 45) = 1.09, p > .3$ ]. Looking times to the congruent and incongruent approach events also did not differ from one another or from those of the overlapping sample of participants in the Powell and Spelke (2018a) experiment (see the Supplemental Materials [Powell & Spelke, 2018b]).

**(a) Interaction Events: Center character responds to side target characters**

(i) Imitative Interaction

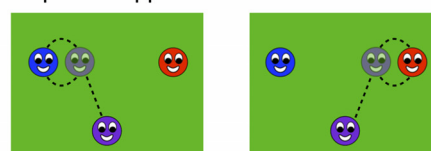


(ii) Nonimitative Interaction



**(b) Approach Events: One character approaches & moves synchronously with another**

(i) Responder Approach Events



(ii) Target Approach Events

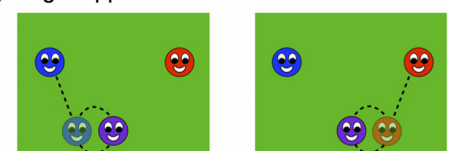


Figure 3. Illustrations of scenes from Experiment 3.



In the final preference test, infants showed no looking preference between the target ( $M = 6.44$  s) and nontarget of imitation [ $M = 6.03$  s;  $F(1, 48) = 0.24$ ,  $p > .6$ , Figure 2b]. There was no interaction between preferential looking and approach type (see the Supplemental Materials [Powell & Spelke, 2018b] for other interaction effects). A repeated-measures ANOVA comparing looking times during the preference test in the successful conditions of Experiments 1 and 2 (*responder approach* and *no approach*) to the matched conditions from Experiment 3 (*target approach* and *no approach*) revealed a significant interaction [ $F(1, 88) = 7.59$ ,  $p < .01$ ], indicating that infants' preference to look at imitators over nonimitators was reliably stronger than their preference to look at targets of imitation over nontargets (see the Supplemental Materials [Powell & Spelke, 2018b]).

The results of Experiment 3 provide no evidence that young infants preferentially attend to targets of imitation. This result speaks against a familiarity-based explanation of the imitator preferences in Experiments 1 and 2, and it disconfirms the hypothesis that infants perceive imitative interactions as more positive than nonimitative ones and thus prefer all participants involved in imitative events. Finally, Experiment 3 provided no evidence that infants perceive imitation as an indicator of the imitated target's prestige, although prestige may influence infants' preferences in other contexts.

#### EXPERIMENT 4

Experiments 1 and 2 provide evidence that 4-month-old infants selectively attend to imitators who repeat or align with a target character's sound. Experiment 4 tests the generalization of this preference to a new age, imitative behavior, and outcome measure.

In Experiments 1 and 2, imitators matched the sounds made by the target. Although imitation of vocalizations and of actions function similarly in adult social interactions (Chartrand & Lakin, 2013; Giles & Powesland, 1975), it is possible that infants prefer imitators of sounds but not movements. Experiment 4 tests infants' relative preference for characters that do and do not imitate the movements of a model character.

Experiments 1 and 2 used a behavioral measure, preferential looking, that can reflect a variety of motivations. Preferential looking in early infancy sometimes precedes unambiguously prosocial responses to the same social cues later in infancy (Hamlin, Wynn, Bloom, & Mahajan, 2011; Kinzler et al., 2007), but it does not always do so (Kinzler & Spelke, 2011). Moreover, looking can be driven by the perception of novelty or potential for information gain (Kidd, Piantadosi, & Aslin, 2012; Kinney & Kagan, 1976), even in contexts with the potential to elicit true social preferences (e.g., Quinn, Yahr, & Kuhn, 2002; Ramsey, Langlois, & Marti, 2005). Experiment 4 therefore probes infants' preference for imitators further by using a different measure of social preference: selective reaching. Reaching can be an exploratory behavior (Ruff, 1978; Stahl & Feigenson, 2015), but when it is directed to social characters it primarily reflects an infant's motivation to approach them (e.g., Hamlin, Wynn, & Bloom, 2007).

Experiment 4 was conducted with 12-month-old infants, and it explores the relationship between the imitator preference observed in Experiments 1 and 2 and another social preference attributed to infants: a preference for helpful individuals (e.g., Hamlin et al., 2007; Hamlin & Wynn, 2011). In simple situations, a helpful actor's behavior often mimics that of her beneficiary. For example, one helps a child put away toys by engaging in the same action. In research investigating infants' evaluation of helpful individuals, nearly all of the depicted scenarios have involved helpful behaviors that are imitative: a puppet goes up a hill, pushing

another puppet who has attempted the same climb, or tosses back a ball that another puppet has tossed to him, or pulls upward on the lid of a box that another puppet also has attempted to lift (e.g., Hamlin et al., 2007; Hamlin & Wynn, 2011; Kuhlmeier, Wynn, & Bloom, 2003). The imitative nature of these acts of helping raise the possibility that infants' preference for helpers is driven by the helper's imitation of the beneficiary, rather than by the helper's impact on the achievement of the beneficiary's goals. Experiment 4 tests the feasibility of this interpretation by asking if infants recognize the mimicry involved in a helping behavior and prefer those who engage in this mimicry, even if the context is changed such that the behavior is not, in fact, helpful to the beneficiary.

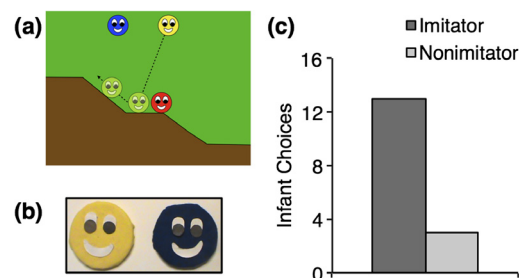
The experiment was modeled on a helping scenario featuring a protagonist who attempts to climb a hill, as well as a helper who pushes the protagonist to the top and a hinderer who pushes the protagonist toward the bottom (Hamlin et al., 2007). The current events differed in one crucial respect: the actions of the former helper (now the imitator) and hinderer (now the nonimitator) were arranged such that they did not impact the achievement of the protagonist's goal. The experiment concluded with the measure of preference most often used to assess infants' relative preference for helpers and hinderers: a preferential reaching test.

**Methods**

Sixteen 11.5- to 13.5-month-old infants saw six interaction events featuring three characters, all initially positioned at the top of the screen above a hill (Figure 4a). In each event, the central character moved from the bottom of the hill up to a middle platform and then engaged in two failed attempts to climb the second slope (Hamlin et al., 2007; Kuhlmeier et al., 2003). In imitative interaction events, one of the two remaining characters landed in front of the central character and copied its efforts to climb the hill, successfully reaching the upper platform on the second attempt. In nonimitative events, the other character landed on the top of the hill and then moved down the upper slope and back up twice, ending on the top platform where it started (Movie S3). Each interaction event was followed by an infant-controlled pause. Then a display-blind experimenter presented the infants with physical copies of the imitator and nonimitator, testing which character infants would reach for first (see the Supplemental Materials [Powell & Spelke, 2018b] for details).

**Results and Discussion**

During familiarization, looking times following imitation events ( $M = 10.19$  s) did not differ from those following nonimitation events [ $M = 11.76$  s;  $t(15) = 1.30$ ,  $p > .2$ ]. Infants were significantly more likely to reach for the imitator than the nonimitator (13/16, binomial



**Figure 4. Scenes and preferential reaching results, Experiment 4.** (a) Imitative action by the yellow character. (b) Physical characters presented during the reaching test. (c) Number of infants that reached first for the imitator and nonimitator.



probability test:  $p < .05$ ; Figure 4c). Low-level aspects of the characters' motion are unlikely to account for this result, because infants look and reach equally for agents who go uphill versus downhill in the absence of a social partner (Hamlin et al., 2007), and both test characters moved toward and away from the central character to similar extents. These results thus extend the preference for imitators observed in the first two experiments to a new age, a new measure of preference, and a new target action that has received considerable attention in studies of infants' response to helpful and unhelpful agents. It is possible that infants have a true preference for those who help others. When a helpful action involves imitating the beneficiary's attempted efforts, however, this matching can elicit an imitation-based preference even in the absence of the helpful effect. Research investigating infants' preference for helpers therefore should present either nonimitative helping behaviors or should test infants' preference for characters who imitate with helpful versus neutral consequences.

### **GENERAL DISCUSSION**

The present experiments provide four main findings. First, 4.5-month-old infants preferentially attend to parties who imitate the sounds made by their interaction partner over parties that respond nonimitatively (Experiments 1 and 2). Second, when the same imitative and non-imitative responses are directed toward two different targets, infants fail to show any preference to attend to the imitated target (Experiment 3). Third, infants' third-party preference for imitators generalizes across age groups (~4.5 and 12.5 months), imitation modality (sound and motion), and behavioral measures (preferential looking and reaching). Finally, at least some helpful behaviors involve imitative components that can elicit a preferential approach from infants in the absence of any helpful impact.

The current findings align with prior research, supporting a cohesive picture of young infants' responses to social imitation. The prior research suggested that imitative interactions carry social meaning for young infants, insofar as they support expectations of imitators' future affiliative behavior (Powell & Spelke, 2018a). The present finding that infants themselves prefer imitators suggests that young infants perceive imitation as a prosocial action that both indicates the imitator's affiliative motivations toward its target and warrants positive evaluation of the imitator. Future research can further test this hypothesis by characterizing the parameters that affect infants' preferences. Comparing responses to imitators, nonimitators, and non-responding individuals can determine whether infants prefer imitators, disprefer nonimitators, or both. Research varying the characters' animacy or access to one another can test if infants' preference is rooted in a perception of the imitator and target as interaction partners. (For preliminary evidence that infants' preference depends on the imitator's perceptual access to the target's behavior, and for further evidence that infants preferentially approach imitators in a larger sample of participants, tested with the reaching method used here, see Powell & Spelke, 2017.)

What could account for the perception of imitators as prosocial? As detailed above, neither homophily nor familiarity preferences can explain the current findings. We suggest instead that a preference for imitators helps infants (and older children and adults) identify individuals with the capacity and motivation for social engagement. Interacting with or helping a social partner requires abilities and propensities for social perception and attention and for socially coordinated action. Because imitation demonstrates these building blocks of prosocial behavior, infants' preference for imitators may therefore foster engagement with prosocial individuals, even before infants achieve the action representations and goal attributions required for understanding acts of helping and cooperation.

## ACKNOWLEDGMENTS

Thanks to Ellyn Schmidt, Heather Kosakowski, Margaret Barrow, Tess Davison, Sydney Jenkins, Natasha Kalra, and Natalie Saragossa-Harris for assistance with data collection and reliability coding, and to Susan Carey, Rebecca Saxe, Jesse Snedeker, Josh Tenenbaum, and Tomer Ullman for criticisms and suggestions.

## FUNDING INFORMATION

Elizabeth S. Spelke, National Institutes of Health (<http://dx.doi.org/10.13039/1000000002>), Award ID: 5R01HD023103. Elizabeth S. Spelke, National Science Foundation (<http://dx.doi.org/10.13039/1000000001>), Award ID: CCF-1231216. Lindsey J. Powell, Simons Foundation (<http://dx.doi.org/10.13039/100000893>).

## AUTHOR CONTRIBUTIONS

Lindsey J. Powell: Conceptualization: Equal; Data curation: Lead; Formal analysis: Lead; Funding acquisition: Supporting; Investigation: Lead; Methodology: Lead; Project administration: Lead; Writing—original draft: Lead; Writing—review & editing: Equal. Elizabeth S. Spelke: Conceptualization: Equal; Funding acquisition: Lead; Writing—review and editing: Equal.

## REFERENCES

- Agnetta, B., & Rochat, P. (2004). Imitative games by 9-, 14-, and 18-month-old infants. *Infancy, 6*, 1–36.
- bar-Haim, Y., Ziv, T., Lamy, D., & Hodes, R. M. (2006). Nature and nurture in own-race face processing. *Psychological Science, 17*, 159–163.
- Barr, R., Dowden, A., & Hayne, H. (1996). Developmental changes in deferred imitation by 6-to 24-month-old infants. *Infant Behavior and Development, 19*, 159–170.
- Byrne, D., & Griffitt, W. (1966). A developmental investigation of the law of attraction. *Journal of Personality and Social Psychology, 4*, 699–702.
- Carpenter, M., Uebel, J., & Tomasello, M. (2013). Being mimicked increases prosocial behavior in 18-month-old infants. *Child Development, 84*, 1511–1518.
- Chartrand, T. L., & Bargh, J. A. (1999). The chameleon effect: The perception–behavior link and social interaction. *Journal of Personality and Social Psychology, 76*, 893–910.
- Chartrand, T. L., & Lakin, J. L. (2013). The antecedents and consequences of human behavioral mimicry. *Annual Review of Psychology, 64*, 285–308.
- Chudek, M., Heller, S., Birch, S., & Henrich, J. (2012). Prestige-biased cultural learning: Bystander’s differential attention to potential models influences children’s learning. *Evolution and Human Behavior, 33*, 46–56.
- Cooke, L. (2007). The importance of exposure for healthy eating in childhood: A review. *Journal of Human Nutrition and Dietetics, 20*, 294–301.
- Fawcett, C. A., & Markson, L. (2010). Similarity predicts liking in 3-year-old children. *Journal of Experimental Child Psychology, 105*, 345–358.
- Giles, H., & Powesland, P. F. (1975). *Speech style and social evaluation*. Oxford, England: Academic Press.
- Hamlin, J. K., & Wynn, K. (2011). Young infants prefer prosocial to antisocial others. *Cognitive Development, 26*, 30–39.
- Hamlin, J. K., Wynn, K., & Bloom, P. (2007). Social evaluation by preverbal infants. *Nature, 450*, 557–559.
- Hamlin, J. K., Wynn, K., Bloom, P., & Mahajan, N. (2011). How infants and toddlers react to antisocial others. *Proceedings of the National Academy of Sciences, 108*, 19931–19936.
- Haun, D. B. M., & Over, H. (2015). A homophily-based account of human culture. In P. J. Richerson & M. H. Christiansen (Eds.), *Cultural evolution: Society, technology, language, and religion* (pp. 117–130). Cambridge, MA: MIT Press.
- Henrich, J., & Gil-White, F. J. (2001). The evolution of prestige: Freely conferred deference as a mechanism for enhancing the benefits of cultural transmission. *Evolution and Human Behavior, 22*, 165–196.
- Jones, S. S. (2007). Imitation in infancy: The development of mimicry. *Psychological Science, 18*, 593–599.
- Kidd, C., Piantadosi, S. T., & Aslin, R. N. (2012). The “Goldilocks” effect: Human infants allocate attention to visual sequences that are neither too simple nor too complex. *PLoS ONE, 7*, e36399.
- Kinney, D. K., & Kagan, J. (1976). Infant attention to auditory discrepancy. *Child Development, 47*, 155–164.
- Kinzler, K. D., Dupoux, E., & Spelke, E. S. (2007). The native language of social cognition. *Proceedings of the National Academy of Sciences, USA, 104*, 12577–12580.
- Kinzler, K. D., & Spelke, E. S. (2011). Do infants show social preferences for people differing in race? *Cognition, 119*, 1–9.
- Kokkinaki, T., & Kugiumutzakis, G. (2000). Basic aspects of vocal imitation in infant-parent interaction during the first 6 months. *Journal of Reproductive and Infant Psychology, 18*, 173–187.

- Kuhlmeier, V., Wynn, K., & Bloom, P. (2003). Attribution of dispositional states by 12-month-olds. *Psychological Science, 14*, 402–408.
- LaFrance, M. (1979). Nonverbal synchrony and rapport: Analysis by the cross-lag panel technique. *Social Psychology Quarterly, 42*, 66–70.
- Lakin, J. L., Jefferis, V. E., Cheng, C. M., & Chartrand, T. L. (2003). The chameleon effect as social glue: Evidence for the evolutionary significance of nonconscious mimicry. *Journal of Nonverbal Behavior, 27*, 145–162.
- Mahajan, N., & Wynn, K. (2012). Origins of “us” versus “them”: Prelinguistic infants prefer similar others. *Cognition, 124*, 227–233.
- Mehr, S. A., Song, L. A., & Spelke, E. S. (2016). For 5-month-old infants, melodies are social. *Psychological Science, 27*, 486–501.
- Meltzoff, A. N. (1988). Infant imitation and memory: Nine-month-olds in immediate and deferred tests. *Child Development, 59*, 217–225.
- Meltzoff, A. N. (1990). Foundations for developing a concept of self: The role of imitation in relating self to other and the value of social mirroring, social modeling, and self practice in infancy. In D. B. M. Cicchetti (Ed.), *The self in transition: Infancy to childhood* (pp. 139–164). New York, NY: Cambridge University Press.
- Neimeyer, R. A., & Mitchell, K. A. (1988). Similarity and attraction: A longitudinal study. *Journal of Social and Personal Relationships, 5*, 131–148.
- Over, H., & Carpenter, M. (2015). Children infer affiliative and status relations from watching others imitate. *Developmental Science, 18*, 917–925.
- Peery, J. C., & Peery, I. W. (1986). Effects of exposure to classical music on the musical preferences of preschool children. *Journal of Research in Music Education, 34*, 24–33.
- Powell, L. J., & Spelke, E. S. (2017, September 30). *The role of perceptual access in infants’ third party evaluations of imitation*. Retrieved from [psyarxiv.com/63tyq](https://psyarxiv.com/63tyq).
- Powell, L. J., & Spelke, E. S. (2018a). Human infants’ understanding of social imitation: Inferences from third party observations. *Cognition, 170*, 31–48.
- Powell, L. J., & Spelke, E. S. (2018b). Supplemental materials for “Third-party preferences for imitators in preverbal infants.” *Open Mind: Discoveries in Cognitive Science, 1*(4), 183–193. doi:10.1162/opmi\_a\_00018.
- Quinn, P. C., Yahr, J., & Kuhn, A. (2002). Representation of the gender of human faces by infants: A preference for female. *Perception, 31*, 1109–1121.
- Ramsey, J. L., Langlois, J. H., & Marti, N. C. (2005). Infant categorization of faces: Ladies first. *Developmental Review, 25*, 212–246.
- Ruff, H. A. (1978). Infant recognition of the invariant form of objects. *Child Development, 49*, 293–306.
- Stahl, A. E., & Feigenson, L. (2015). Observing the unexpected enhances infants’ learning and exploration. *Science, 348*, 91–94.
- van Baaren, R. B., Holland, R. W., Kawakami, K., & van Knippenberg, A. (2004). Mimicry and prosocial behavior. *Psychological Science, 15*, 71–74.
- van Baaren, R. B., Holland, R. W., Steenaert, B., & van Knippenberg, A. (2003). Mimicry for money: Behavioral consequences of imitation. *Journal of Experimental Social Psychology, 39*, 393–398.
- Zajonc, R. B. (1968). Attitudinal effects of mere exposure. *Journal of Personality and Social Psychology, 9*, 1–27.