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Once a frog-lover, always a frog-lover?: Infants' goal generalization is influenced by the nature of accompanying speech

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Abstract

The ability to interpret choices as enduring preferences that generalize beyond the immediate situation gives adults a powerful means of predicting and explaining others' behavior. How do infants come to recognize that current choices can be driven by generalizable preferences? Although infants can encode others' actions in terms of goals at 3 months (Woodward, 1998), there is evidence that 10-month-olds still fail to generalize goal information presented in one environment to an event sequence occurring in a new environment (Sommerville & Crane, 2009). Are there some circumstances in which infants interpret others' goals as generalizable across environments? We investigate whether the vocalizations a person produces while selecting an object in one room influences infants' generalization of the goal to a new room. Ten-month-olds did not spontaneously generalize the actor's goal, but did generalize the actor's goal when the actor initially accompanied her object selection with a statement of preference. Infants' generalization was not driven by the attention-grabbing features of the statement or the mere use of language, as they did not generalize when the actor used matched nonspeech vocalizations or sung speech. Infants interpreted the goal as person-specific, as they did not generalize the choice to a new actor. We suggest that the referential specificity of accompanying speech vocalizations influences infants' tendency to interpret a choice as personal rather than situational.

Keywords

infant cognition; goal attribution; theory of mind; generalization; reference

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People's actions reveal information about their mental states. If Sally grabs an apple from the fruit bowl, you might reasonably think that Sally wants an apple. Yet, by the same token, people's actions don't necessarily reveal how stable the mental states that underlie a particular action are. If Sally grabs an apple, does this mean that apples are Sally's favorite

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fruit, or that Sally is just in the mood for an apple today but may not be tomorrow? How do we decide whether a simple action (reaching for an apple) reflects a transient choice (Sally wants an apple), or an enduring mental state such as a preference (Sally loves apples) that will cause similar choices in different environments (Sally will always choose apples; if you're shopping for Sally you should buy apples; etc.)? Adults, at least in Western cultures, tend to quickly foreclose on a person-centered (rather than situation-centered) explanation, interpreting others' actions as caused by the enduring mental states and traits of those individuals instead of features of the environment (Ross, 1977; Savani, Markus, & Connor, 2008; Savani, Markus, Naidu, Kumar, & Berlia, 2010; Todorov & Uleman, 2004; Winter & Uleman, 1984). From this perspective, Sally's apple selection is caused by a stable preference for apples rather than environmental factors. A bias for making stable person-centered inferences can sometimes lead to errors (Gilbert & Malone, 1995; Jones, 1979), but also provides a powerful and often reliable means of predicting and explaining others' behavior.

A critical question, then, concerns the developmental emergence of person-centered causal attributions for others' behavior. How do infants come to recognize that simple actions can be driven by stable individual mental states that endure beyond the immediate environment? A good starting point to investigate the early origins of these attributions is in the domain of understanding others' goals, because we know that young infants are able to represent actions as goal-directed very early in life. For instance, after receiving training designed to improve their ability to produce object-directed reaches, when infants as young as 3 months of age see an agent consistently approach object A over object B, they later look longer when the actor approaches B even though the objects have switched locations (Sommerville, Woodward, & Needham, 2005). Thus infants perceive approach actions as choices for particular objects rather than mechanical movements toward particular locations.

Infants' understanding of object-directed action becomes more refined with age. At 6 months, infants use information about agents' object goals to predict agents' future actions, and expect agents to pursue their goals in an efficient way (Csibra, 2008; Johnson, Ok, & Luo, 2007; Luo, 2011; Skerry, Carey, & Spelke, 2013; Woodward, 1998). At 9 months, infants bind goals to specific individuals, consistent with an understanding of the subjective nature of preferences (Buresh & Woodward, 2007; Henderson & Woodward, 2012; c.f., Egyed, Kiraly, & Gergely, 2013). And by at least 12 months, infants represent goals in terms of categories of objects rather than individual instances; for instance, if an actor reaches for a doll over a truck, infants expect the actor to reach for a different doll over a different truck later on, but do not distinguish between a reach for the initial doll over a new different doll (Spaepen & Spelke, 2007). There is also evidence that infants' goal representations do not just consist of associating particular agents with particular objects; rather, infants consider an agent's perspective when deciding how to interpret the agent's object selection. For instance, if an actor selectively reaches for a doll over a truck, 6-month-olds encode the actor's goal as the doll *only* if the actor could see both objects when making the initial selection (Luo & Baillargeon, 2007; Luo & Johnson, 2009). Together, these studies suggest that infants make coherent, abstract, person-specific, and possibly mentalistic inferences about others' object-directed actions within the first year of life.

Given that infants can make these goal inferences from witnessing object-directed actions, it may be that infants, like adults, readily extend these inferences across situations. That is, infants' goal attributions might reflect person-centered interpretations of behavior which they generalize to new environments. If so, these interpretations could include representations of enduring mental states which cause action across situations (e.g., "She likes dolls", "She prefers dolls over trucks"), or could be interpretations that are person-centered and generalizable but without any mental state content. However, a different possibility altogether is that infants, unlike adults, do not tend to spontaneously generalize their goal inferences across environments. That is, infants' goal attributions might reflect situation-centered interpretations of behavior as bound to a particular environment.

No studies have yet tested between these two alternatives. Some research hints at the second possibility—that infants' goal attributions are more situationally-bound than we might expect. Ten-month-old infants can use information they have learned about an actor's goal (e.g., the actor repeatedly reaches for a frog toy) to interpret an ambiguous action performed by the actor later on (e.g., the actor pulls a cloth that the frog toy is resting on)—but not if the goal information and later ambiguous actions are presented in different rooms (Sommerville & Crane, 2009). If infants do not spontaneously extend goal information to a new room, how do infants' goal inferences support prediction of behavior in new environments? Perhaps there are certain types of evidence infants capitalize on to determine that a person-centered interpretation, and therefore generalization to a new environment, is warranted.

One type of evidence that infants might use to determine that a person- rather than situation-centered interpretation of a choice is warranted is cross-situational statistics. That is, if infants see a person choose dolls over trucks in multiple environments, they might reasonably attribute to the person a preference for dolls, and predict that the person will continue to choose dolls over trucks in new environments. It is reasonable to think infants might use this sort of cue given that they are able to use statistical information to make sense of people's actions (Xu & Denison, 2009; Xu & Garcia, 2008). However, extracting this kind of information in daily life would require extensive evidence and time (i.e., the opportunity to see agents act on similar objects in a range of environments). Adults do not require such extensive experience; they are able to attribute enduring preferences to others based on single instances of their choices (Markus & Kitayama, 2003).

Another powerful and more immediately available cue infants might use is additional evidence of a person's interest in a specific object. For instance, adults and children are more likely to predict that an actor will make similar choices across environments when the choice is initially described to them in terms of the actor's preference or liking than when it is described as a choice (Garvin & Woodward, 2015; Winter & Uleman, 1984 Kalish, 2002; Rhodes & Gelman, 2008). Might this sort of additional evidence also lead infants to form a person-centered interpretation of a goal?

We hypothesize that the speech an individual produces when making a choice can influence whether infants interpret the choice as personal rather than situational. There are many reasons to think that the type of speech accompanying an individual's behavior would provide infants with a particularly good cue for predicting the same individual's future actions. Infants use speech to organize their physical and social environment from the time they are born. They prefer speech over other sounds from birth (Vouloumanos & Werker, 2007) and link some familiar speech sounds to familiar objects as early as 6 months of age (Bergelson & Swingley, 2012; Tincoff & Jusczyk, 1999; 2011). Infants use novel words, but not emotional expressions like "Wow!", to individuate objects (Xu, Cote, & Baker, 2005; c. f. Robinson & Sloutsky, 2008). Around the end of the first year, infants differentiate speech presented in a referential or naming phrase (e.g., "It's a doll!") from isolated expressions (e.g., "Wow!"), speech that might draw attention to objects but does not typically pick out specific objects (e.g., "Look!"; Fennel & Waxman, 2010), or speech presented in a nonreferential context (e.g., emanating from a baby monitor; Campbell & Namy, 2003).

Infants also use accompanying speech to make inferences about people's actions. Six-month-olds expect that an actor who looks behind a barrier and speaks is talking to a person rather than an object (Legerstee, Barna, & DiAdamo, 2000). Six- and 12-month-olds recognize that novel speech tokens (e.g., "koba"), but not emotional expressions (e.g., "oooh!") or physiological sounds (e.g., coughing), can communicate information about an individual's goal object (Martin, Onishi, & Vouloumanos, 2012; Vouloumanos, Martin, & Onishi, 2014), and 12-month-olds also recognize that speech can communicate about intentions (Vouloumanos, Onishi, & Pogue, 2012). At 14 months, speech helps infants to determine whether an individual's action is accidental (e.g., "Whoops!") or intentional (e.g., "There!"; Carpenter, Akhtar, & Tomasello, 1998). Thus infants have many specific expectations about the form and function of speech, long before they can produce many words. Here we ask whether the type of speech accompanying an actor's object selection influences infants' tendency to make a person-centered rather than a situation-centered interpretation of an actor's choice[1]. We use infants' generalization of an actor's goal (to obtain a target object) to a new environment as a measure of a person-centered interpretation. We use a new room as a new environment because previous research shows that infants may not spontaneously generalize goal information even between similar-looking rooms (Sommerville & Crane, 2009).

The current studies investigate (1) whether infants spontaneously generalize information about an actor's goal to a new environment, and (2) whether the nature of accompanying vocalizations influences infants' generalization.

General Method

Habituation Phase

The procedure was modeled after Woodward (1998) – that is, infants were repeatedly exposed to an actor's object-directed action using a habituation paradigm, and were tested on either a change in target object or a change in reach location. Infants in all experiments received habituation trials in Room A. During habituation, infants sat on their parent's lap

[1]We use "person-centered" to indicate an interpretation in which a goal is bound to a specific person and is generalizable across environments, and "situation-centered" to indicate an interpretation in which a goal is bound to a specific environment and not generalizable to new environments.

about 80 cm in front of a tabletop display. First, infants saw a preview trial in which they were exposed to the display table with the two objects, a toy frog and a toy car, resting on the surface approximately 30 cm apart. After infants looked away from the display for 2 seconds, the trial ended and the event was hidden from infants' view (see Setup). Next, the actor sat down at the table equidistant between the two toys. Then, habituation trials began. At the start of each habituation trial, the actor looked at the infant and said, "Hi!" then looked at each object (first the object to her left, then the object to her right). The actor then looked at the infant and said, "Look!" and picked up the target toy. The identity of the target (frog or car) and its position on the table (left or right) were counterbalanced across infants. After picking up the object, the actor produced a positive vocalization, which differed across experiments and conditions. The actor held the target toy and smiled until the trial ended (when the infant had looked away for 2 s or at a maximum length of 120 s). Habituation trials were presented until infants' total looking on three successive trials fell to half of their total looking on the first three consecutive trials (i.e., infants received a minimum of 6 habituation trials), or at a maximum of 14 habituation trials.

Test Phase

After habituation, infants received test trials in Room B (except in Experiment 2 in which test trials were presented in Room A). An experimenter transitioned parents and infants from Room A to Room B, a process that took approximately 60 s per infant. During test trials, infants sat about 80 cm from a new tabletop display. Infants first saw a pretest trial in which they were exposed to the frog and car toys, which now occupied reversed positions on the table (i.e., if the frog was on the right in habituation, it was on the left in test). Infants then saw six test trials. As in habituation, in each test trial the actor looked at the infant and said, "Hi!" then looked at each object (right, then left), looked at the infant again and said, "Look!". Infants then saw 3 pairs of alternating test trials in which the actor reached for the target or non-target toy. In non-target trials, the actor reached to the same side of the display as she had reached to during habituation trials and grasped a different toy than she had during habituation trials. During target trials, the actor reached to a different side of the display and grasped the same toy she had selected in habituation. The toy selected on the first test trial (target or non-target) was counterbalanced across infants. After picking up the object in each test trial, the actor held her pose smiling at the object until the trial ended.

The actors were kept blind to study hypotheses and unaware of the results of the experiments to avoid any potential bias; for example, actors (undergraduate students) did not attend lab meetings in which the study was discussed. Actors were not told what object to reach for in test trials until after the habituation phase was complete. Before acting in the experiments, actors went through a training and checking process, and were instructed to always look straight at the toy after picking it up in each trial. The primary experimenter verified online that the actor followed this protocol.

Setup

About half of the experiments were conducted in one pair of rooms (Room Pair 1) and the other half in a different pair of rooms (Room Pair 2). The reason for this was that the lab moved to a new building during data collection. The two Room Pairs were set up similarly;

both Room Pairs had a habituation room (Room A) and a test room (Room B), and all rooms had similar tabletop displays. There were two main differences between the Room Pairs. The first difference was in the distance between the rooms. In Room Pair 1, Room A was down the hall from room B; in Room Pair 2, Room A was directly across the hall from Room B. Transition times between habituation and test took about 60 s between Room A and Room B in both Room Pairs. The second difference was in how the display was occluded from infants between trials. In Room Pair 1, parents turned their infant around in a swivel chair between habituation trials (Room A), and a curtain covered the display between trials in test trials (Room B); in Room Pair 2, a curtain covered the display between trials in both Room A and Room B. See Figure 1 for images of the habituation and test events in Room Pair 1.

Online Looking-Time Coding

In both habituation and test, infants' looking was timed from the moment the actor said "Look!" until the infant looked away for 2 s to end the trial (or for a maximum duration of 120 s). Looking time was calculated on-line by a trained live coder who was unaware of the condition to which the infant was assigned. The coder watched the infant on a video monitor and activated a computer program by pressing a button when the infant was looking at the display (Casstevens, 2007). A reliability coder coded infants' eye gaze off-line after the experiment.

Vocabulary Assessment

In order to assess infants' receptive vocabularies, parents completed the short-form MacArthur Communicative Development Inventory prior to taking part in the experiment (Fenson, Pethick, Renda, Cox, Dale, & Reznick, 2000). The number of words that infants understood was summed and entered into subsequent analyses.

Experiment 1

Experiment 1 investigated whether 10-month-old infants can generalize an actor's goal to a new environment, and whether their generalization is influenced by the utterance the actor produced when selecting an object in habituation. Infants were randomly assigned to a Choice condition or a Preference condition. For infants in the Choice condition, the actor produced a generic positive expression, "Wow!", when she grasped the target object in habituation. For infants in the Preference condition, the actor made a verbal statement of preference including the label of the target object, "I like frogs!" or "I like cars!", when she grasped the target object in habituation.

Experiment 1 was conducted in 2 parts. A full sample of 16 infants per condition (Choice, Preference) was collected in Room Pair 1. Another full sample of 16 infants per condition (Choice, Preference) was collected in Room Pair 2 when the lab moved, in order to ensure that results were not specific to a particular location or configuration of rooms. Our decision to collect 16 infants per condition was based on the most common sample size from studies using the Woodward (1998) procedure (e.g., Guajardo & Woodward, 2004; Hamlin, Newman, & Wynn, 2009; Hernik & Southgate, 2012; Luo & Baillargeon, 2007; Luo & Johnson, 2009; Woodward, 1998; 1999;)[2]. However, in Experiment 1 we collected a double sample in each condition to ensure sufficient power to detect any effect of experimental setting (Room Pair) on the results.

The habituation and test events were conceptually identical in both Room Pairs; we made one change when running in Room Pair 2 to the actor's vocalizations. In the Room Pair 1 Preference condition the actor said, "Wow, I like frogs!" or "Wow, I like cars!" in habituation, and in the Room Pair 1 Choice condition the actor just said, "Wow!" in habituation. The actor always said "Wow!" in test. In the Room Pair 2 Preference condition the actor said, "I like frogs!" or "I like cars!" in habituation, and in the Room Pair 1 Choice condition the actor just said, "Wow!" in habituation. The actor always picked up the object silently in test. We made this change in Room Pair 2 for two reasons. First, we were interested in the influence of the type of utterance (a statement of preference vs. an emotional expression) on infants' goal generalization, and were concerned that by including both in the Preference condition we were merely giving infants a *longer* vocalization rather than a different *sort* of vocalization. Second, we wanted the test events to be silent so they were not more similar to the habituation events of one condition than the other.

In our analyses we include Room Pair (1 or 2) in addition to Condition (Choice or Preference) and Test Event Type (Target or Non-target) as factors.

Participants

Sixty-four infants participated in the experiment: 32 in Room Pair 1 (15 females; mean age = 9 months, 22 days, range = 9 months, 17 days to 10 months, 2 days) and 32 in Room Pair 2 (20 females; mean age = 10 months, 0 days, range = 9 months, 20 days to 10 months, 13 days). Infants in all experiments were full term (at least 37 weeks gestation), typically developing, and recruited using a database maintained by the university at which the research was conducted. Infants tested in Room Pair 2 were screened for language and all heard at least English at least 50% of the time in their daily lives.

Nineteen additional infants were excluded (12 from Room Pair 1, 7 from Room Pair 2) because of fussiness or crying ($n = 7$), inattentiveness ($n = 5$), procedural errors ($n = 4$), total looking time in test trials over 2SD from the condition mean ($n = 2$), sibling interference ($n = 1$), or a significant preference for one of the objects reported by parent ($n = 1$). For 2 infants tested in Room Pair 2 (one in the Preference condition and one in the Choice condition), only 2 test trial pairs were used in analyses (rather than all 3) because the infant did not look at the display at all for at least one of the test trials in the pair.

Results

Reliability coding—Reliability coding across test trials was computed separately for each Room Pair. In Room Pair 1, the two coders agreed on the ending of 93.8% of trials in the Choice condition and 92.7% of trials in the Preference condition. Disagreements were

[2]We conducted a post-hoc power analysis based on 3 previous studies using the Woodward (1998) procedure with infants around 10 months of age: Guajardo & Woodward (2004); Sommerville & Crane (2009), and Woodward (1999). Effects ranged from approximately d = 0.5 to d = 1.0 (average d = .75). With 16 subjects per condition, we achieve power of .88 to detect an effect of d = .75 in a paired t-test.

categorized into two groups: those that would have contributed to the hypothesized pattern of findings and those that would have worked against the hypothesized pattern of findings. Disagreements were randomly distributed across these categories for both the Choice condition (Fisher's exact test, $p > .9$) and the Preference condition (Fisher's exact test, $p > .1$).[3]

In Room Pair 2, the two coders agreed on the ending of 90.9% of test trials in the Choice condition, and 94.7% of test trials in the Preference condition. Disagreements were randomly distributed across the two categories for both the Choice condition (Fisher's exact test, $p > .9$) and the Preference condition (Fisher's exact test, $p > .3$).

Habituation trials—In both Room Pairs, infants in the two conditions showed similar levels of attention in the habituation phase. A Room Pair x Condition ANOVA revealed only a significant main effect of Room Pair on infants' number of trials to habituation, $F = 10.29$, $p < .01$, $\eta_p^2 = .148$, and total looking time in habituation, $F = 8.29$, $p < .01$, $\eta_p^2 = .123$ such that infants tested in Room Pair 1 habituated in fewer trials ($M = 7.41$ trials to habituation) and thus had lower total looking times in habituation than infants tested in Room Pair 2 ($M = 9.69$ trials to habituation).

Test trials—We first conducted a preliminary ANOVA looking for effects of the toy on the actor's right, the side the actor first reached to in test, and test trial order (target first or non-target first) on infants' total looking times in target vs. non-target test trials. There were no significant main effects or interactions except for a 4-way interaction. Because the 4-way interaction was not predicted and did not result in significant 2-way interactions when broken down, we do not discuss it further and collapse across these variables in the primary analyses.

For the primary analyses we conducted a mixed ANOVA on infants' looking time in test with Room Pair (1 or 2) and condition (Choice or Preference) as between-subjects factors and test trial type (target or non-target) as a within-subjects factor. This analysis revealed a significant interaction between condition and test trial type, $F(1, 56) = 5.26$, $p < .03$, $\eta_p^2 = .086$ and no other main effects or interactions. Infants in the Preference condition looked significantly longer at non-target events ($M = 27.31$, $SE = 2.57$) than target events ($M = 21.21$, $SE = 2.06$), $t(31) = 3.44$, $p < .01$, $d = .61$, whereas infants' looking time in the Choice condition did not differ significantly between non-target ($M = 25.61$, $SE = 1.92$) and target events ($M = 26.45$, $SE = 2.07$), $t(31) = .34$, $p = .74$, $d = .06$. See Figure 2 for results of all experiments.

Separate t-tests for each Room Pair confirmed that the same effect held in both Room Pairs. Infants tested in Room Pair 1 looked significantly longer at non-target events than target events in the Preference condition, $t(15) = 2.41$, $p < .03$, $d = .60$, but not the Choice condition, $t(15) = .15$, $p = .88$, $d = .04$. Infants tested in Room Pair 2 also looked

[3]Reliability analyses were conducted for all Experiments. Across experiments, 9 infants were not reliability coded because their videos were missing due to experimenter error or mechanical failure. Because reliability between the coders was high in all experiments, we felt confident using the live coder's data for these infants.

significantly longer at non-target events than target events in the Preference condition, $t(15) = 2.40$, $p = .03$, $d = .60$, but not the Choice condition, $t(15) = .343$, $p = .74$, $d = .09$.

Nonparametric analyses confirmed that there was an association between infants' test trial looking preference and condition. We calculated a test trial type preference score by subtracting infants' looking times on the target test trials from their looking on the non-target test trials. We included in this analysis only infants whose preference score was at least 1 second. Across the two Room Pairs, 26 of 30 infants in the Preference condition looked longer to the non-target events, whereas 13 of 29 infants in the Choice condition did so (Fisher's exact test, $p < .001$). Separate binomial tests for each Room Pair confirmed that the same effect held in both Room Pairs. In Room Pair 1, 14 of 16 infants in the Preference condition looked longer to the non-target events, $p < .01$, whereas 6 of 16 infants in the Choice condition did so, $p = .45$. In Room Pair 2, 12 of 14 infants in the Preference condition looked longer to the non-target events, $p < .02$, whereas 7 of 15 infants in the Choice condition did so, $p = 1.00$.

Vocabulary scores—We next assessed the relation between infants' test trial type preference score and their vocabulary comprehension score. All infants are included in vocabulary analyses regardless of their preference score. Because there were no effects of Room Pair in any of the main analyses, we collapsed across the two Room Pairs here. On average (collapsing across the two Room Pairs), parents reported that infants understood 8.7 ($SE = 1.15$) words in the Preference condition and 10.9 ($SE = 1.76$) words in the Choice condition ($p = .31$).

To investigate the relation between infants' preference for the non-target events and the number of words understood, we ran a multiple linear regression. The model was not statistically significant, $F(3,60) = 2.02$, $p = .12$, nor was the Condition by Vocabulary interaction term, $t(59) = 0.61$, $p = .55$. Thus, we found no relation between infants' looking time preferences in test and their receptive vocabulary scores.

Experiment 2

In Experiment 1, infants generalized an actor's goal to a new room if the actor produced a preference statement ("I like frogs/cars!") but not a positive expression ("Wow!") when grasping the target object in habituation. These results suggest that infants may take a situation-centered interpretation of a goal unless there is evidence to suggest otherwise, here in the form of a statement of preference. However, this interpretation of the results requires that infants in both conditions *attributed* a goal to the actor based on their exposure to her object selection in habituation, but only infants in the Preference condition interpreted the goal as person-centered and generalizable to a new environment. Did infants in the Choice condition attribute a goal to the actor and interpret it as bound to the initial environment, or did these infants not attribute a goal at all?

Experiment 2 examines whether infants attribute a goal to an actor who says "Wow!" during habituation, by testing whether infants expect the actor to pursue the same goal in the same room. Ten-month-old infants were tested in a Choice condition identical to Experiment 1

(Room Pair 1) except that both habituation and test trials were conducted in the same room, Room A. After habituation, an experimenter walked parents and infants out of the room and then back into the room to begin test trials, a process that took approximately 60 s, matched to the transition time between rooms in Experiment 1. We matched the transition time because we were interested in whether infants in the Experiment 1 Choice condition failed to generalize because of the delay between habituation and test or because the test was in a new environment.

If infants attribute a goal to the actor based on her object selection but interpret this goal as bound to the immediate environment, they should look longer to non-target than target test events when tested in the same room. If infants do not attribute a goal at all, their looking time should not differ between non-target and target test events.

Participants

Sixteen infants participated in the experiment (10 females; mean age = 9 months, 22 days, range = 9 months, 15 days to 10 months, 4 days). Seven additional infants were excluded because of fussiness or crying ($n = 3$), procedural errors ($n = 3$), or total looking time in test trials over 2SD from the experiment mean ($n = 1$).

Results

Reliability coding—The two coders agreed on the ending of 96.9% of trials. Disagreements were categorized into two groups: those that would have contributed to the hypothesized pattern of findings and those that would have worked against the hypothesized pattern of findings. Disagreements were randomly distributed across these categories (Fisher's exact test, $p = 1.00$).

Habituation trials—The average number of trials to habituation was $M = 7.56$, and was similar to the average number of trials to habituation in the Room Pair 1 Choice condition of Experiment 1 ($M = 7.75$), $F = .052$, $p = .82$, $\eta_p^2 = .002$.

Test trials—A preliminary ANOVA revealed no significant interactions between the toy on the actor's right, the side the actor first reached to in test, test trial order, and infants' total looking times to target vs. non-target test events. Subsequent analyses collapsed across these variables.

Infants looked significantly longer at non-target events ($M = 27.27$ s) than target events ($M = 20.78$ s), $t(15) = 2.28$, $p < .04$, $d = .57$. Nonparametric analyses on infants whose preference score was at least 1 second yielded similar results. Ten of 13 infants looked longer to the non-target events, $p = .092$. This effect likely did not reach significance because of the small sample size ($n = 13$).

Vocabulary scores—On average, parents reported that infants understood 4.7 ($SE = 1.02$) words. Infants' preference for the non-target events was not significantly related to the number of words they understood, $r = .094$, $p = .74$.

Experiment 3

Infants attributed a goal upon repeated exposure to an actor's object selection, and expected the actor to continue pursuing this goal in the same environment after a brief delay (Experiment 2). However, they did not make a person-centered interpretation of the goal and generalize it to a new environment unless the actor accompanied her initial object selection with a statement of preference (Experiment 1).

We have argued that infants in the Preference condition of Experiment 1 are making a person-centered interpretation of the goal. If so, infants should generalize the goal across environments, but not across people. Therefore, we predict that if infants in the Preference condition see a *new* actor doing the reaching in test, their looking time should not differ between target and non-target test events. However, there are at least 2 alternative explanations to the idea that the actor's production of a preference statement led infants to switch from a situation-centered to person-centered interpretation. One is that the statement led infants to form a stronger memory representation of the object itself. Another is that infants interpreted the statement of preference as informative not about the actor's interest in the target object, but instead about the objective value of the object itself (Egyed et al., 2013; Gergely, Egyed, & Kiraly, 2007). Both of these alternative explanations predict that infants if in the Preference condition see a new actor doing the reaching in test, they should look longer to non-target than target test events. Experiment 3 tests between these alternatives.

Habituation was identical to the Preference condition of Experiment 1: the actor said, "I like frogs!" or "I like cars!" while selecting the target object, in Room A. Then, a *different* actor was featured in the test trials, reaching alternately for the target and non-target object, in Room B.

Participants

Sixteen infants participated in the experiment (10 females; mean age = 9 months, 24 days, range = 9 months, 15 days to 10 months, 0 days). Two additional infants were excluded because of fussiness or crying ($n = 2$). For 1 infant, only 2 test trial pairs were used in analyses (rather than all 3) because the infant did not look at the display at all for at least one of the test trials in the pair.

Results

Reliability coding—The two coders agreed on the ending of 94.7% of trials. Disagreements were categorized into two groups: those that would have contributed to the hypothesized pattern of findings and those that would have worked against the hypothesized pattern of findings. Disagreements were randomly distributed across these categories (Fisher's exact test, $p = 1.00$).

Habituation trials—The average number of trials to habituation was $M = 7.62$, and was similar to the average number of trials to habituation in the Room Pair 1 Preference condition of Experiment 1 ($M = 7.0$ trials), $t(30) = .84$, $p = .41$, $d = .31$.

Test trials—A preliminary ANOVA revealed no significant interactions between the toy on the actor's right, the side the actor first reached to in test, test trial order, and infants' total looking times in target vs. non-target test events. Subsequent analyses collapsed across these variables.

Infants' looking time did not differ significantly between non-target events ($M = 19.32$ s) and target events ($M = 18.38$ s), $t(15) = .35$, $p = .73$, $d = .09$. Nonparametric analyses on infants whose preference score was at least 1 second showed that 9 of 15 infants looked longer to the non-target events, $p = .61$.

Vocabulary scores—On average, parents reported that infants understood 7.4 ($SE = 1.30$) words. Infants' preference for the non-target events was not significantly related to the number of words they understood, $r = -.17$, $p = .53$.

Experiment 4

Infants in Experiment 3 did not generalize one actor's goal to a new actor (see also Buresh & Woodward, 2007; Henderson & Woodward, 2012). This suggests that the preference statement leads infants to make a person-centered attribution of the habituation actor's goal, rather than strengthening infant memory for the object or indicating its objective value. Experiments 4–7 focus on why the statement has this effect.

One possibility is that attentional factors that differ between the Choice and Preference conditions can explain why infants generalize the actor's goal in one condition and not the other. For example, perhaps the verbal statement "I like frogs" was more interesting to infants than "Wow", and more effective at drawing their attention to the association between the actor and the object. Notably, there were no differences in time to habituation between the Choice and Preference conditions (in both Room Pairs), so infants did not have more sheer exposure or time to learn about the actions in either condition. However, in Experiment 4 we made the Choice condition more attention grabbing by having the actor perform an interesting action with the toy, turning it back and forth playfully 3 times, while saying, "Wow!". If engaging infants' attention during the initial object selection is sufficient to lead infants to generalize, infants should look longer to non-target than target events in test.

Participants

Sixteen infants (9 females; mean age = 9 months, 25 days, range = 9 months, 17 days to 19 months, 9 days) participated in the experiment. Eleven additional infants were excluded because of fussiness or crying ($n = 2$), inattentiveness ($n = 7$), procedural error ($n = 1$), or total looking time in test trials over 2SD from the experiment mean ($n = 1$).

Results

Reliability coding—The two coders agreed on the ending of 88.9% of trials. Disagreements were categorized into two groups: those that would have contributed to the hypothesized pattern of findings and those that would have worked against the hypothesized pattern of findings. Disagreements were randomly distributed across these categories (Fisher's exact test, $p > .4$).

Habituation trials—The average number of habituation trials in this experiment ($M = 7.2$ trials) was similar to the average number of habituation trials in the Room Pair 1 Preference condition of Experiment 1 ($M = 7.0$ trials), $F(1,30) = .087$, $p = .77$, $\eta_p^2 = .003$.

Test trials—A preliminary ANOVA revealed no significant interactions between the toy on the actor's right, the side the actor first reached to in test, test trial order, and infants' total looking times in target vs. non-target test trials. Subsequent analyses collapsed across these variables.

Infants' looking time did not differ significantly between non-target events ($M = 22.32$ s) and target events ($M = 19.56$ s), $t(15) = 1.08$, $p = .30$, $d = .25$. Nonparametric analyses were conducted for each condition on infants whose preference score was at least 1 second. Nine of 16 infants looked longer to the non-target events, $p = .80$.

Vocabulary scores—On average, parents reported that infants understood 8.7 ($SE = 2.17$) words. Infants' preference for the non-target events was not significantly related to the number of words they understood, $r = -.28$, $p = .32$).

Experiment 5

In Experiment 4, having the actor play with the selected toy to make the selection more attention-grabbing did not lead infants to generalize the choice to the new room. However, perhaps the manual action of turning the toy was simply not as attention-grabbing as a vocalization for drawing infants' attention to the choice. Experiment 5 approaches the question of whether infants generalized the goal in the Experiment 1 Preference condition for attentional reasons by using a non-speech-like vocalization matched in length, prosody, and positive intonation to "I like frogs/cars!". When choosing the target object in habituation, the actor vocalized, "Wah wah wah". If the length of the utterance or the positive emotional information conveyed by its prosody was responsible for infants' generalization in the Preference condition of Experiment 1, infants should look longer to non-target than target test events here as well.

Participants

Sixteen (7 females; mean age = 9 months, 20 days, range = 9 months, 6 days to 9 months, 25 days) infants participated in the experiment. Seven additional infants were excluded because of fussiness or crying ($n = 3$), inattentiveness ($n = 3$), or procedural error ($n = 1$).

Results

Reliability coding—The two coders agreed on the ending of 97.9% of trials. Disagreements were categorized into two groups: those that would have contributed to the hypothesized pattern of findings and those that would have worked against the hypothesized pattern of findings. Disagreements were randomly distributed across these categories (Fisher's exact test, $p > .9$).

Habituation trials—The average number of habituation trials in this experiment ($M = 7.4$ trials) was similar to the average number of habituation trials in the Room Pair 1 Preference condition of Experiment 1 ($M = 7.0$ trials), $F(1,30) = .40$, $p = .53$, $\eta_p^2 = .01$.

Test trials—A preliminary ANOVA revealed no significant interactions between the toy on the actor's right, the side the actor first reached to in test, test trial order, and infants' total looking times in target vs. non-target test trials. Subsequent analyses collapsed across these variables.

Infants' looking time did not differ significantly between non-target events ($M = 22.63$ s) and target events ($M = 20.91$ s), $t(15) = .54$, $p = .60$, $d = .13$. Nonparametric analyses were conducted for each condition on infants whose preference score was at least 1 second. Seven of 14 infants looked longer to the non-target events, $p = 1.0$.

Vocabulary scores—On average, parents reported that infants understood 7.1 ($SE = 1.81$) words. Infants' preference for the non-target events was not significantly related to the number of words they understood, $r = -.34$, $p = .20$.

Experiment 6

Increasing the attention-grabbing features of the object selection event in habituation did not lead infants to generalize the actor's goal (Experiments 4 and 5), but the actor's production of a verbal preference statement did (Experiment 1 Preference condition). What is it about the verbal statement that influenced infants' generalization?

One feature of the statement that might influence infants' generalization is that it consistently maps a specific word (e.g., "frog") onto a specific object (the toy frog). Even if they were not familiar with the word "frog", infants in the Preference condition of Experiment 1 may have inferred that the actor was repeatedly naming the particular object she liked. Previous work suggests that consistent labels can lead infants to encode information that they might otherwise not. For example, 12-month-old infants in one study were more likely to notice similarities between exemplars and make inferences about category membership when a consistent label, but not variable labels, accompanied the exemplars (Waxman & Braun, 2005). Infants also expect distinct labels to refer to distinct kinds of objects in individuation tasks (e.g., Dewar & Xu, 2007).

However, another possibility is that it is the act of producing a preference statement rather than the consistency of the label used that leads infants to form a person-centered interpretation of the actor's goal and generalize it to a new situation. If it is the act of producing the statement rather than the *content* of the statement per se, then infants might generalize the actor's choice to the new room even if the actor varied the object label across trials. Experiment 6 tested between these alternatives. The procedure was identical to the procedure of the Experiment 1 Preference condition (Room Pair 2) except that instead of saying, "I like frogs/cars!" in all habituation trials, the actor used a different nonsense label on each trial (e.g., trial 1: "I like feps!"; trial 2: "I like guds!"; trial 3: "I like plores!").

Participants

Sixteen 10-month-old infants (9 females; mean age = 10 months, 1 day, range = 9 months, 23 days to 10 months, 6 days) participated in the experiment. All infants were exposed to English at least 50% of the time in their home environment. Five additional infants completed the experiment, but were not included in the final sample because of fussiness or crying ($n = 3$), procedure error ($n = 1$), or total looking time in test over 2SD from the experiment mean ($n = 1$).

Results

Reliability coding—The two coders agreed on the ending of 91.7% of trials. Disagreements were categorized into two groups: those that would have contributed to the hypothesized pattern of findings and those that would have worked against the hypothesized pattern of findings. Disagreements were randomly distributed across these categories (Fisher's exact test, $p > .9$).

Habituation trials—The average number of trials to habituation was $M = 8.44$, and was similar to the average number of trials to habituation in the Room Pair 2 Preference condition of Experiment 1 ($M = 10.44$), $t(30) = 1.69$, $p = .10$, $d = .62$.

Test trials—A preliminary ANOVA revealed a significant interaction between test trial order and infants' total looking times in target vs. non-target test trials. There were no effects of toy on the actor's right, or the side the actor first reached to in test. Test trial order was included as a variable in the primary analyses.

The ANOVA on infants' total looking times in target vs. non-target trials x test trial order (target first or non-target first) revealed a significant interaction, $F(1,14) = 7.49$, $p < .02$, $\eta_p^2 = .348$, as well as a significant main effect of test looking preference, F(1,14) = 9.37, $p < .01$, $\eta_p^2 = .401$, such that infants looked significantly longer to non-target ($M = 30.01$ s) than to target events ($M = 23.65$ s). Infants in the non-target-first order looked significantly longer to non-target than target events, $t(7) = 3.89$, $p < .01$, $d = 1.37$, and infants in the target-first order did not show a significant difference in looking time to the two types of event, $t(7) = .243$, $p = .81$, $d = .09$.[4] This order effect is likely due to infants' natural decline in attention across test trials. Infants look longer during earlier trials; thus, if infants prefer to look at non-target trials and these trials are seen earlier, the looking preference is magnified. If the target trials are earlier, the difference is reduced.

Nonparametric analyses on infants whose preference score was at least 1 second (i.e., their looking time differed by one second, in either direction, to the two test events) support evidence of infants' preference for non-target trials in this experiment. Ten of 12 infants looked longer to the non-target events, $p < .04$.

[4]Given the effect of test trial order in Experiment 6, we went back to Experiment 1 to see whether there is a similar effect when broken down into the Preference and Choice conditions. In the Preference condition (where the actor produced a consistent label), there was a marginal interaction between test trial order and infants' test trial preference, $F(1,30) = 4.09$, $p = .052$, $\eta_p^2 = .120$. As in Experiment 6, these infants' looking time was longer to non-target trials no matter what they had seen first, but the difference was larger for infants who saw a non-target trial first. In the Choice condition (where the actor said "Wow!"), there was no effect of order, $F(1,30) = 1.35$, $p = .255$, $\eta_p^2 = .043$.

Vocabulary scores—On average, parents reported that infants understood 11.8 (SE = 2.23) words. Infants' preference for the non-target events was not significantly related to the number of words they understood, $r = .06$, $p = .83$.

Experiment 7

The results of Experiment 6 provide intriguing evidence that it may be the act of producing a statement, rather than the repeated use of a consistent object label, that influenced infants' tendency to generalize the goal. We hypothesized that the referential specificity of the utterance may be a key factor in influencing infants' goal generalization. But another feature that differs between the conditions in which infants have generalized the actor's goal and the ones in which they have not is the amount of speech used. Is it the production of a referentially specific utterance that influences infants' goal generalization, or is it the uttering of a longer string of words ("I like frogs!" or "I like guds!" rather than just "Wow!")?

Testing between these alternatives requires a condition where the actor uses speech in a way that is not typically used to refer to specific objects. Experiment 7 was identical to the Preference condition of Experiment 1 (Room Pair 2) except that instead of saying, "I like frogs/cars!" in habituation, the actor sang part of a song when she selected the target in habituation: "Twinkle twinkle little star!". We used a song that most parents sing to their infants because it is unlikely that infants construe it as an utterance referring to specific objects in the environment. However, the song does contain words, so if it is the production of multiple words that leads infants to generalize the goal to a new environment, they should do so here as well. If the referential specificity of the utterance is doing the work, then infants should not generalize the goal when the actor accompanies her choice with sung speech.

Participants

Sixteen 10-month-old infants (10 females; mean age = 10 months, 0 days, range = 9 months, 24 days to 10 months, 5 days) participated in the experiment. All infants were exposed to English at least 50% of the time in their home environment. One additional infant completed the experiment, but was not included in the final sample because of total looking time in test over 2SD from the experiment mean.

Results

Reliability coding—The two coders agreed on the ending of 94.4% of trials. Disagreements were categorized into two groups: those that would have contributed to the hypothesized pattern of findings and those that would have worked against the hypothesized pattern of findings. Disagreements were randomly distributed across these categories (Fisher's exact test, $p > .9$).

Habituation trials—The average number of trials to habituation was $M = 10.44$, and was similar to the average number of trials to habituation in the Room Pair 2 Preference condition of Experiment 1, $t(30) = .43$, $p = .67$, $d = .16$.

Test trials—A preliminary ANOVA revealed a significant interaction between test trial order and infants' total looking times in target vs. non-target test trials. There were no effects of toy on the actor's right, or the side the actor first reached to in test. Test trial order was included as a variable in the primary analyses.

The ANOVA on infants' total looking times in target vs. non-target trials x test trial order (target first or non-target first) revealed no significant main effect or interaction (ps > .05). Infants' looking time did not differ significantly between non-target (M = 25.47 s) and target events (M = 24.29 s). Because there was an effect of test trial type in preliminary analyses, we conducted separate t-tests on infants' looking preference in test for infants who received target vs. non-target trials first. For infants who saw a target event first, looking time did not differ significantly between non-target (M = 24.04 s) and target (M = 26.40) test events, $t(7) = 1.17$, $p = .28$, $d = .41$, and for infants who saw a non-target event first, looking time did not differ significantly between non-target (M = 26.91 s) and target (M = 22.17) test events, $t(7) = 1.69$, $p = .14$, $d = .60$. Nonparametric analyses on infants whose preference score was at least 1 second showed that 6 of 12 infants looked longer to the non-target events, $p = 1.00$.

Vocabulary scores—On average, parents reported that infants understood 9.12 (SE = 1.55) words. Infants' preference for the non-target events was not significantly related to the number of words they understood, $r = .18$, $p = .51$.

General Discussion

Infants spontaneously attribute goals to others' object-directed actions before their first birthday (Woodward, 1998), yet, at 10 months, infants do not spontaneously generalize these goals to a new environment. When an actor made a consistent object selection in one room and accompanied it by a generic positive expression, "Wow!", infants showed no expectation that the actor would make the same choice in a new room (but did expect the actor to make the same choice in the same room after a time delay). However, if the actor accompanied her object selection with a preference statement including a consistent (e.g., "I like frogs") or variable object label (e.g., "I like guds!", "I like feps!"), infants expected the actor to make the same choice in the new room.

Our results suggest that accompanying a choice with these statements leads infants to make a person-centered rather than situation-centered interpretation of the choice. Infants did not generalize the goal to a *new* actor in a new room, even if the first actor initially accompanied her object selection with a preference statement[5]. Infants also did not generalize the goal to the *same* actor in a new room when the actor initially accompanied her selection with attention-grabbing nonspeech vocalizations or actions.

[5]Further evidence that infants' generalization was not driven by developing their own personal preference for the target object or by an assessment of its objective value comes from an infant choice post-test which we conducted in all experimental conditions run in Room Pair 2 (i.e., with vocalizations "I like [frogs/cars]", "Wow", "I like guds/feps/plores", "Twinkle twinkle little star!"). Once test trials were complete, the primary experiment instructed parents to move their chair closer to the display, close their eyes, and hold infants centered in their lap. The experimenter then raised the curtain and infants saw the two objects on the table within their reach (equidistant from the infant, on the same sides of the tabletop as in test trials). The actor was absent from the display. The trial ended when infants had touched one of the two objects, and infants' choices were coded offline from the video by two coders unaware of condition assignment. In no condition did infants show a significant preference for the target or non-target object (all ps > .33, binomial sign tests). Thus infants' generalization was independent of their own interest in a particular object.

What features of these preference statements lead infants to interpret an individual's choice as personal rather than bound to the immediate environment? Infants generalized the goal whether the actor used a consistent label ("I like frogs!") or a variable label ("I like feps/guds/plores!"), suggesting that it was not the presence of a consistent label highlighting the object or category that led to generalization. The mere production of language is also not enough to lead infants to form a person-centered interpretation, as infants did not generalize the goal if the actor used language in the context of a familiar song ("Twinkle twinkle little star!"). We consider three possibilities regarding the features of the utterances that led infants to generalize, ending with a discussion of the one we consider most likely.

One straightforward explanation is that perhaps infants recognize the word "like" as an indication of preference, and are more likely to make a person-centered interpretation of the goal when an actor produces this word during her selection. However, if the differences between conditions were solely driven by the presence or absence of the word "like", it would suggest that 10-month-olds recognize "I like" but not "Wow!" as indicating positivity or excitement about an object. This seems unlikely given that exclamations like "Wow!" are familiar to infants and frequently used when interacting with various objects (Namy & Waxman, 2000), and infants interpret them as positive in social referencing contexts (e.g., Moses, Baldwin, Rosicky, & Tidball, 2001; Repacholi, 1998). Additionally, previous work suggests that 10-month-olds are only beginning to show understanding of the meaning of abstract words (such as "like"), and the abstract words they do know are ones that are most common in parents' child-directed speech (e.g., "eat", "bye-bye"; Bergelson & Swingley, 2013) and tend to be words that are at least sometimes presented in isolation (Brent & Siskind, 2001). However, further research could directly test whether the presence of "like" drives generalization, by presenting infants with an actor who produces a referentially specific utterance which does not include the word "like" (e.g., "It's a frog").

A second possibility is that the use of a generic noun (e.g., "frogs" or "guds") plays an important role in infants' tendency to generalize goals across situations. We know that infants are biased to interpret words as referring to kinds, and generic nouns suggest more generalizable information for infants and children (Gelman & Bloom, 2007; Xu, 2002). Perhaps it is the use of generic labels, whether consistent or variable, that drives infants to infer that the information they are encoding (in this case, the actor's object selection) is more generalizable. If so, infants should be less likely to generalize the goal if the actor instead made a statement like, "I like this gud" rather than "I like guds". However, we offer this possibility quite speculatively, given the evidence that it is only around 30 months that children begin to distinguish between generic and nongeneric word forms (Graham, Nayer, & Gelman, 2011).

A third possibility, which we favor, is that the referential specificity of the utterances influenced infants' interpretation of the actor's goal. We use the term "referentially specific" to refer to words or patterns of speech that are relatively more likely to map to one object or category of objects. Words that take the form of nouns such as "frog" or "gud" are more referentially specific in this sense; the word "frog" is not sometimes used to talk about frogs and sometimes about cats. Expressions like "wow" are less referentially specific as they are used to express excitement about any number of things. Sung speech, and in particular the song “Twinkle twinkle little star”, is typically not used to refer to objects in the environment at all.

We suggest that the use of a spoken utterance, containing a word that takes the form of an appropriate object label, heightens the referential specificity of the utterance for infants. Previous work has shown that infants differentiate between lexical words (e.g., nouns like “chair”) and grammatical words (e.g., “you, that”; Shi & Werker, 2001) as well as between noun-like words and linguistic sounds or function words (MacKenzie, Curtin, & Graham, 2012; MacKenzie, Graham, & Curtin, 2011); that infants are more likely to infer that words map to specific objects when they are presented in a naming phrase (Fennel & Waxman, 2010; Fulkerson & Waxman, 2007); and that words that take the form of nouns typically map to individual objects while positive expressions like “wow” do not (Xu et al., 2005). Therefore, infants in our experiments may have detected the increased referential specificity of a spoken utterance containing a noun-like word, and as a result were more likely to interpret the goal as person-centered and generalizable across environments. If this explanation is correct, we should predict that spoken utterances which do not contain object labels, (e.g., “I like this” or “I like yours”), should not lead infants to generalize. We also predict that referentially specific utterances which do *not* contain preference terms such as “like” (e.g., “It’s a frog”) should lead infants to generalize.

The finding that infants generalized the actor’s goal even when the actor had used variable labels to refer to the object suggests that it may be the *act* of producing a referentially specific utterance rather than the consistency in the *content* of that utterance, that leads infants to form a person-centered interpretation of the object selection. This pattern builds on existing evidence that infants have some abstract expectations of what speech or language does, beyond considering what any given phrase might mean (e.g., Martin et al., 2012). One interesting open question is whether other referential actions that do not take the form of speech (for instance, if the actor pointed at the object with her other hand while grasping it) would lead infants to generalize the goal.

We have argued that the actor’s speech influences infants’ interpretation of the goal as person-centered (“Her goal is to get the frog”). This implies that infants who did not hear the preference statement during actor’s initial object selection did not simply forget about the actor’s goal when they entered the new room, but rather did not expect the actor to pursue the same goal (e.g., “In that room, her goal was the frog; here, I don’t know.”). Yet it is also possible that the actor’s speech instead influences the strength of infants’ goal representation and, thereby, their memory for the actor-object association in the new room. That is, a more referentially specific utterance, or an utterance containing the word “like”, may promote more robust encoding of the goal that survives a typically-disruptive change in environment. Either of these possibilities could constitute a “situation-centered interpretation”. In one, infants in the different conditions encode similar goal representations but do not always apply them in a new environment; in the other, infants form a less robust goal representation in the first place if there is reason to think it may not apply in new environments. Though more research is required to identify the specific mechanism of the effect, in either case the actor’s statement has an important influence on the information infants encode from the actor’s object selection.

It is perhaps surprising that infants do not spontaneously generalize an individual's goal to a new and similar environment, given that their goal representations seem abstract (Skerry, Carey, & Spelke, 2013), robust (Csibra, 2008; Woodward, 1998), person-specific (Buresh & Woodward, 2007; Henderson & Woodward, 2012), and possibly mentalistic (Johnson et al., 2007; Luo, 2011) by their first birthday. However, these findings are in a sense quite consistent. At 10 months of age, infants may construe goals as context-bound in more ways than one; in our own Experiment 3, and in previous research (Buresh & Woodward, 2007; Henderson & Woodward, 2012), infants around this age did not expect one individual's goal to generalize to a second individual. Perhaps infants' initial stance toward goals is to construe them as contextually restricted, and over time this stance is modified as infants begin to recognize the contextual conditions that are relevant for goal generalization. We show here that 10-month-old infants are not *unable* to form a goal representation that they can carry over to a new situation; they do so when there is evidence of the actor's enduring preference for (or intention to) obtain the target object, here in the form of an accompanying referentially specific utterance. There may also be circumstances in which infants at some age would also expect goals to generalize across individuals (as an adult might) – for instance, two individuals who show a positive social relationship might be expected to have the same preferences (see Liberman, Kinzler, & Woodward, 2014 for evidence of the reverse of this inference in 9-month-olds).

Though infants *can* interpret goals as person-centered and generalizable across environments, our results and previous work (Sommerville & Crane, 2009) suggest they do not always spontaneously do so. Yet adults tend to make dispositional attributions fairly quickly upon seeing limited action evidence, and can do so without accompanying verbal evidence. For example, as adults, when we see Sally choose an apple we typically assume she likes apples (even if she doesn't say it aloud). One open question for future work is whether infants older than 10 months foreclose on person-centered inferences more quickly with limited evidence, in the way adults often do. There may also be important cultural differences in the development of person- and situation-centered interpretations of others' choices, similar to those found in adults (Savani et al., 2008; 2010).

Our results suggest that the development of using person- and situation-centered attributions to explain the choices of other people begins in infancy. When 10-month-old infants see a person choose one object over another and produce a verbal statement, they interpret the choice as specific to that individual and enduring across contexts. Infants do not form this interpretation if the actor accompanies her choice with a general positive expression, attention-grabbing actions, or speech in a typically non-referentially specific form. We show that infants are not *unable* to generalize goal information to a new situation, a question left open by previous work (Sommerville & Crane, 2009), but they do not spontaneously do so unless the goal information is accompanied by other relevant evidence. Infants' interpretations of others' choices are likely tuned across early development as they detect relevant personal (e.g., stable preferences) and situational (e.g., constraints of particular environments) causes that reliably drive regularities in behavior.

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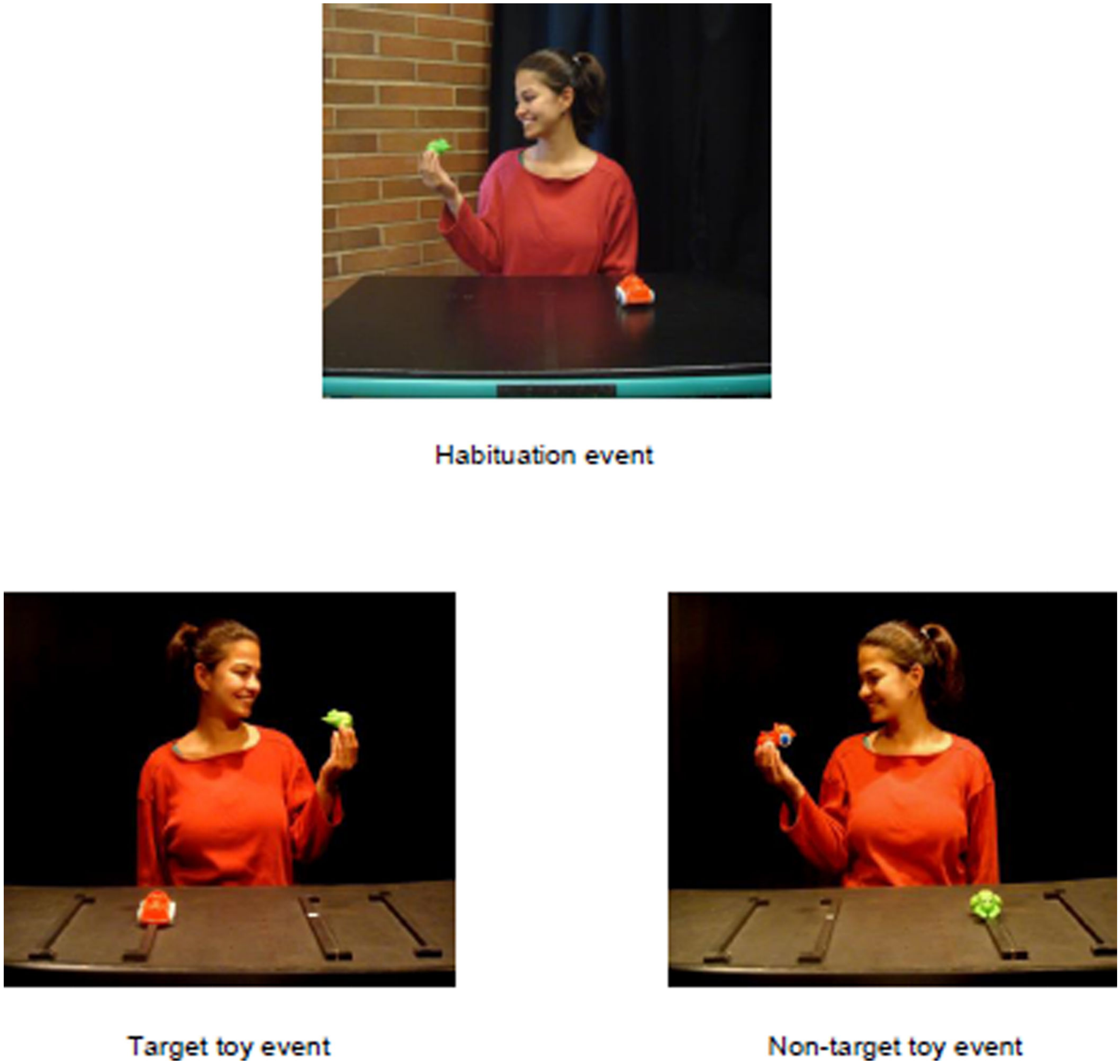

Figure 1.

Habituation paradigm in Room Pair 1. Habituation took place in Room A, where infants saw the actor repeatedly select the target object (here, the frog). Test took place in Room B, where infants saw the actor select the target and non-target objects in 6 alternating trials.

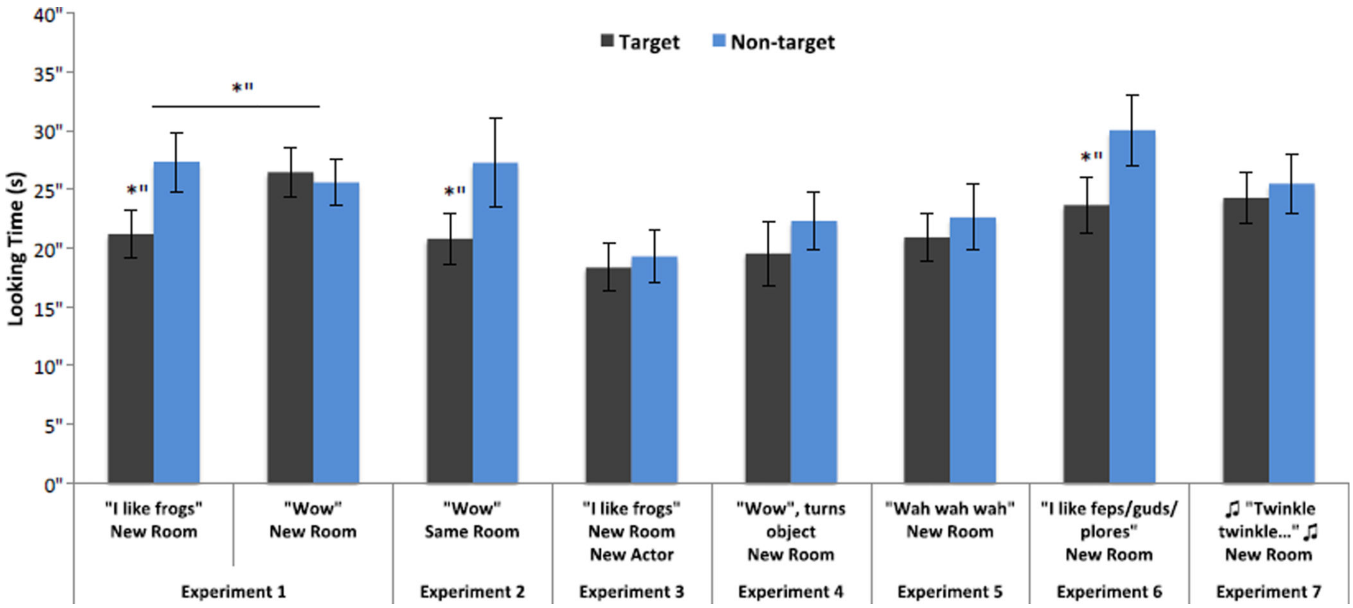

Figure 2.

Infant looking times to target and non-target test trials in each Experiment. Asterisks denote significance at $p < .05$; error bars represent standard error of the mean (SEM).