(This is a sample cover image for this issue. The actual cover is not yet available at this time.)

Infant Behavior & Development 35 (2012) 606–612

Contents lists available at SciVerse ScienceDirect

Infant Behavior and Development

Short communication

Categorization of real and replica objects by 14- and 18-month-old infants☆

Martha E. Arterberry[a,*], Marc H. Bornstein[b,**]

[a] Department of Psychology, Colby College, Waterville, ME, USA
[b] Child and Family Research, Eunice Kennedy Shriver National Institute of Child Health and Human Development, National Institutes of Health, Public Health Service, USA

ARTICLE INFO

Article history:
Received 4 August 2011
Received in revised form 17 February 2012
Accepted 30 April 2012

Keywords:
Categorization
Sequential touching
Symbolic representation

ABSTRACT

In studies of infant categorization (especially sequential touching), replicas of real objects are often utilized on the assumption that infants treat replicas as they do reals. Do infants categorize replicas of objects in the same way as they categorize real objects? This question was addressed in a sequential touching task, where 14- and 18-month-olds were presented with four sets of objects: real telephones and hairbrushes, real lemons and pears, replica telephones and hairbrushes, and replica lemons and pears. On the whole, mean run length, number of contacts, and appropriate actions did not differ between real and replica objects. Moreover, mean run length was significantly greater than chance for telephones and hairbrushes, but not for lemons and pears; both ages categorized the former sets but not the latter. Infants of this age appear to treat replicas as equivalent to reals, and replicas are appropriate stimuli to use in the sequential touching procedure to address questions of infants' categorization.

1. Introduction

Categories structure and clarify cognition, and they allow us to respond to novel entities as if they were familiar (Bornstein, 1984; Harnad, 1987). Categorizing is thus an essential cognitive and developmental achievement, and humans engage in categorization processes very early in life (see Rakison & Oakes, 2003, for a review). A common method for assessing categorization abilities in children aged 12–30 months is the sequential touching procedure (e.g., Bornstein & Arterberry, 2010; Mandler, Bauer, & McDonough, 1991; Mandler, Fivush, & Resnick, 1987). This procedure involves presenting infants with objects from different categories (e.g., four animals and four vehicles) and observing and recording their patterns of touching. The empirical observation is that, if infants recognize a categorical distinction among the objects, they will touch those within a category in succession more than is expected by chance.

The objects used in this procedure are typically 3D replicas of real-world objects, such as toy animals and cars, and researchers assume infants' performance with replicas is the same as it would be with real objects. Replicas typically used in categorization studies are highly iconic and often share near exact physical resemblance (save size, texture, and context) to their real-world referents, and in the sequential touching task infants explore replicas visually and tactually, enhancing their multimodal affordances (Gibon, 1979).

☆ We thank D. Breakstone, C. Hahn, and P. Hruby for assistance. This research was supported by the Intramural Research Program of the NIH, NICHD.

* Corresponding author at: Colby College, 5553 Mayflower Hill, Waterville, ME 04901, USA. Tel.: +1 207 859 5553; fax: +1 207 859 5555.
** Corresponding author at: Child and Family Research, Eunice Kennedy Shriver National Institute of Child Health and Human Development, National Institutes of Health, Rockledge 1, Suite 8030, 6705 Rockledge Drive, MSC 7971, Bethesda, MD 20892-7971, USA.
E-mail addresses: Martha.Arterberry@colby.edu (M.E. Arterberry), Marc_H_Bornstein@nih.gov (M.H. Bornstein).

0163-6383/$ – see front matter © 2012 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.infbeh.2012.04.007

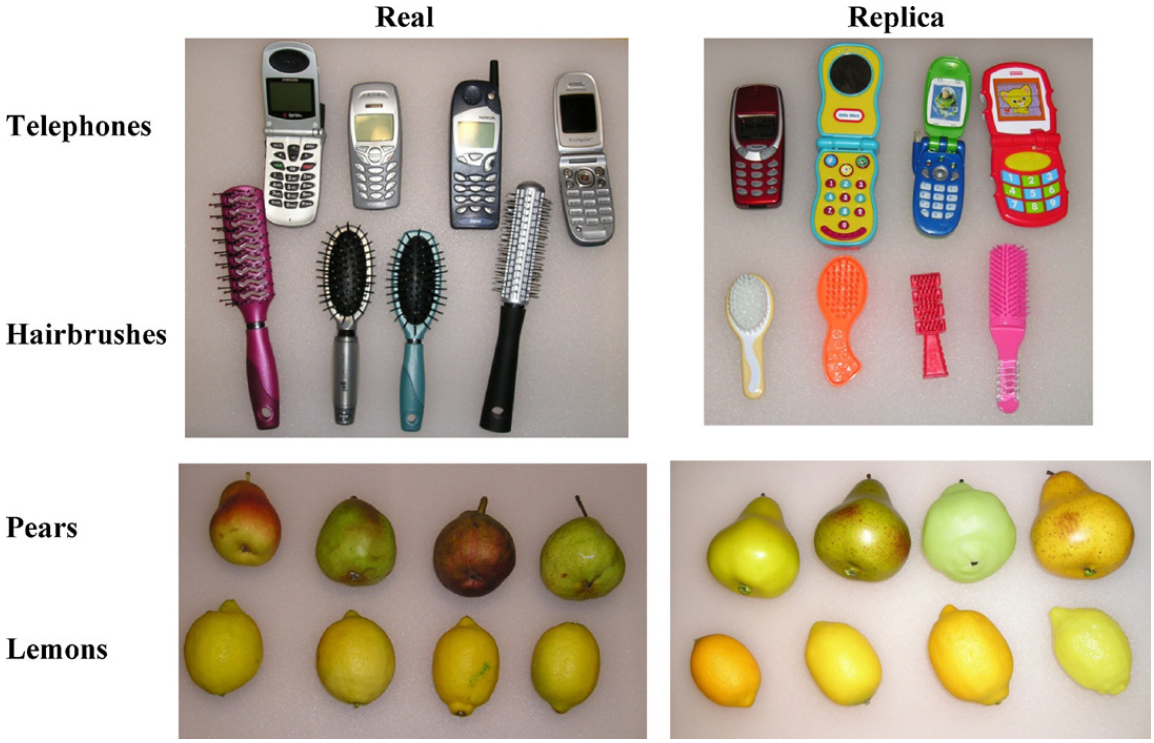

Fig. 1. Real and replica telephones, hairbrushes, lemons, and pears.

However, the evidence regarding whether infants interact with real and replica objects in the same way is mixed. On the one hand, when shown pictures of real-world objects, such as a bottle, 9-month-olds manually explore the pictures by feeling, rubbing, and attempting to grasp the depicted object (DeLoache, Pierroutsakos, Uttal, Rosengren, & Gottlieb, 1998). Also, children between 15 and 30 months commonly commit scale errors, such as trying to put themselves or dolls into objects that are too small to contain them (DeLoache, Uttal, & Rosengren, 2004; Ware, Uttal, Wetter, & DeLoache, 2006). Finally, a substantial experimental and cross-cultural literature attests that children at the start of the second year of life play (even alone) with toy replicas in ways that clearly and validly indicate appropriate self- and other-directed pretense, for example hammering with a replica hammer, tooting on a replica horn, and playing a replica piano (Bornstein, 2006; Tamis-LeMonda, Užgiris, & Bornstein, 2002). On the other hand, in a task in which infants were asked to select an object from among four choices and send it down a chute, 18-month-olds did not reliably select the correct real-world referent when shown a replica (Tomasello, Striano, & Rochat, 1999). Similarly, in a forced-choice preferential looking procedure, following familiarization to a replica (e.g., a hammer), 18-month-olds were inconsistent in looking at a video of a real object that matched the replica (e.g., an actor hammering a nail) as opposed to one that did not match (e.g., an actor brushing hair; Johnson, Younger, & Cuellr, 2005; Johnson, Younger, & Furrer, 2005; Younger & Johnson, 2004).

The present experiment was designed to assess children's categorization of real objects and replicas representing the same objects using the sequential touching methodology. The primary straightforward goal was to determine whether sequential touching performance, and hence conclusions regarding infants' categorization abilities, differed when infants were tested with real objects and their replicas. To this end, 14- and 18-month-olds were presented with four sets of objects. Two sets contained real objects (telephones-hairbrushes and lemons-pears). Two other sets contained replicas of the same real objects (see Fig. 1). The categories were chosen because of the availability of highly iconic replicas and the practicality of real objects that could be used. For example, it would not be feasible to contrast animals and vehicles despite the fact that animal and vehicle replicas are commonly used as stimuli in categorization research (e.g., Bornstein & Arterberry, 2010; Ellis & Oakes, 2006; Kovack-Lesh & Oakes, 2007; Mandler and McDonough, 1993; Rakison & Butterworth, 1998a, 1998b). We purposely selected two different types of object sets – a higher-level distinction (telephones–hairbrushes) that 14- and 18-month-olds have been shown to categorize and a contrasting lower-level distinction (lemons–pears) that infants this age usually do not categorize (Bornstein & Arterberry, 2010; Mandler et al., 1991). The selection of higher- and lower-level category distinctions allowed us to explore more fully possible differences in sequential touching behavior with real and replica objects by comparing this behavior with sets that are and are not typically categorized at this age. Elsewhere we discuss in detail hierarchical organization of categories based on different levels of inclusiveness (Bornstein & Arterberry, 2010).

Infants' mean run length and level of engagement (as assessed by number of contacts) with both real and replica objects were compared. Eighteen-month-olds were included as infants of this age have previously shown inconsistent results in studies addressing their ability to match real and replica objects (e.g., Tomasello et al., 1999; Johnson, Younger, & Cueller, 2005; Johnson, Younger, & Furrer, 2005). Fourteen-month-olds were also tested as the sequential touching procedure is used

Table 1
Mean (*SD*) stimulus weight (in g) and volume (in cm^3).

Set	Condition	Weight	*t* (14)[a]	Volume	*t* (14)[a]
Telephone–hairbrush			2.45*		1.84
	Real	95.75 (51.01)		236.31 (62.40)	
	Replica	42.88 (33.55)		156.90 (105.04)	
Lemon–pear			6.14**		1.17
	Real	181.31 (31.50)		422.59 (188.92)	
	Replica	62.38 (44.75)		329.54 (121.53)	

[a] *t*-Values indicate differences between real and replica objects in each set.
* $p < .05$.
** $p < .01$.

often with infants younger than 18 months. We predicted that mean run lengths would be significantly greater than chance for telephones and hairbrushes for both the real and replica sets, as infants as young as 12 months of age have been shown to categorize objects at high levels of distinction; whereas mean run length for pears and lemons, a low level distinction, would not exceed chance because this categorical distinction does not appear to be present until 30 months (Bornstein & Arterberry, 2010; Mandler et al., 1991). Of interest was whether these patterns would be found regardless of whether infants were tested with real or replica objects.

2. Method

2.1. Participants

Twenty-three 18-month-olds (*M* age = 18.25, *SD* = .26 months; 10 girls) and 14 14-month-olds (*M* age = 14.47, *SD* = .25 months; 5 girls) participated. Families were recruited via purchased mailing lists, and they all came from middle-class socioeconomic status households (*M* = 46.08, *SD* = 12.12, on the Hollingshead, 1975, Four-Factor Index of Social Status; see Bornstein, Hahn, Suwalsky, & Haynes, 2003). Infants had been healthy and term at birth and were healthy at the time of testing. An additional 4 infants started the procedure, but their data were not included due to experimenter error (1) and fussiness (3).

2.2. Materials

2.2.1. Real stimuli

Real objects were used to create two sets of stimuli (see Fig. 1). Each set contained four objects from two categories. The telephone and hairbrush set included four real cell (mobile) telephones (light gray flip, dark gray flip, light gray nonflip, and blue nonflip; averaging 14.43 cm × 4.78 cm × 2.78 cm; 137.50 g) and four adult hairbrushes (red, gray, blue, and black, averaging 19.38 cm × 4.03 cm × 3.60 cm; 54.00 g). The lemon and pear set included four lemons (averaging 8.48 cm × 5.53 cm × 5.63 cm; 153.00 g) and four pears (averaging 9.95 cm × 7.53 cm × 7.75 cm; 209.25 g).

2.2.2. Replica stimuli

Naturalistic three-dimensional scale models were used to create two sets of stimuli (Fig. 1). As with the real stimuli sets, each set contained four replica objects from two categories. The telephone and hairbrush set included four toy cell (mobile) phones (orange flip, red nonflip, yellow flip, and blue flip, averaging 15.10 cm × 5.30 cm × 2.78 cm; 70.00 g) and four toy hairbrushes (yellow, orange, red, and pink, averaging 10.98 cm × 3.40 cm × 2.23 cm; 15.75 g). The lemon and pear set included four lemons (averaging 7.93 cm × 5.33 cm × 5.15 cm; 27.50 g) and four pears (averaging 8.85 cm × 7.03 cm × 7.10 cm; 97.25 g).

2.2.3. Stimuli comparisons

t-Tests were conducted to compare weight and volume (calculated by multiplying the three dimensions, length, width, and height) between the real and replica objects for each set separately (see Table 1). Significant differences in weight between the real and replica stimuli were found for both sets, with the real objects weighing more than the replicas. No differences in volume were found between real and replica stimuli for either set.

2.3. Procedure

The child sat at a small table, and the experimenter sat opposite the child. A camera positioned behind the experimenter focused on the child's head and torso and recorded the child's actions with the objects on each trial.

Infants were tested with all four sets. A within-subjects design was chosen to allow direct comparison across real and replica objects within each child. To address potential concerns that engaging with real and replica objects early in the session would influence performance later in the session; half of the infants started with the real sets, and the other half

Table 2
Mean (*SD*) number of contacts and run lengths.

Set	Condition	Contacts	Run length	*t* (*df*)[a]
Telephone–hairbrush				
14 months	Real	12.79 (2.32)	2.31 (.73)	2.90 (13)*
	Replica	15.26 (5.47)	2.46 (1.34)	1.97 (13)+
18 months	Real	9.39 (3.73)	2.27 (1.19)	1.84 (17)+
	Replica	11.06 (4.89)	3.22 (1.55)	4.02 (17)**
Lemon–pear				
14 months	Real	13.79 (10.81)	2.08 (.82)	1.50 (13)
	Replica	15.21 (7.92)	1.96 (.60)	1.30 (13)
18 months	Real	15.60 (7.80)	1.76 (.51)	.06 (14)
	Replica	12.00 (7.56)	1.61 (.45)	1.17 (14)

[a] *t*-Tests compare mean run lengths to chance, 1.75.
+ $p < .05$ (one tailed).
* $p < .05$ (two tailed).
** $p < .01$ (two tailed).

started with the replica sets. Moreover, the order of sets within condition for each child, and the order of the conditions across infants, was determined randomly. On each trial, the experimenter randomly positioned eight real or replica objects (4 from each category) on a presentation board. After moving the board within easy reach of the infant, the experimenter gave the standard prompt, "These are for you to play with." Infants were allowed to manipulate the stimuli in any way they wished for 2 min with no further prompting. If the child did not touch any of the stimuli after 10 s, the experimenter repeated the original prompt; if the child lost interest within the 2 min, the experimenter encouraged the child's attention back to the stimuli by saying, "These are for you to play with." If an object fell off the table, the experimenter (or parent) unobtrusively replaced it back on the tray.

The video recordings were coded by a single coder who was naive to the hypotheses of the experiment. For each set, the order in which the child contacted the stimuli was coded. Contacts were calculated with replacement, and a stimulus could be contacted more than once, except for two contacts to the same stimulus in succession. A contact was also recorded if the infant used one stimulus intentionally to contact another (e.g., touched a telephone with a hairbrush). A second coder coded a random sample of 25% of the sessions to obtain a measure of coding reliability for sequential touching: mean agreement was 90%. Scoring yielded the total number of contacts, type of action (see below), and the order of objects sequentially contacted in each set of stimuli.

3. Results

Not all 18-month-olds completed all sessions, thus separate analyses were conducted for telephones and hairbrushes and for lemons and pears. To be included in the analyses, infants had to have provided data for both the real and replica conditions for the stimulus category ($N = 18$ for telephones–hairbrushes, $N = 15$ for lemons–pears). Preliminary analyses assessed the effects of gender and order (real first or replica first). No main effects or interactions were found; thus, all analyses are collapsed across girls and boys and set order.

3.1. Mean run length, contacts, and actions

Table 2 shows the mean run length as a function of condition (real, replica) and set type (telephones–hairbrushes, lemons–pears). The first analysis compared each mean run length to chance (1.75; see Mandler et al., 1987, for the derivation of this value). Mean run lengths (*t*-values also shown in Table 2) exceeded chance for real and replica telephones and hairbrushes but not for real or replica lemons and pears, suggesting, as predicted, that infants categorized the former but not the latter object sets.

To test whether there was a difference in infants' categorization of real versus replica objects, a 2×2 ANOVA was conducted with age (14, 18 months) as a between-subjects factor and condition (real, replica) as a within-subjects factor. For telephones–hairbrushes, no main effects or interactions were found, all Fs $< .31$, *ns*. Similar results were found for lemons–pears, with the exception of a marginal main effect for age, $F(1, 27) = 4.13$, $p = .052$: fourteen-month-olds ($M = 2.02$, $SE = .12$) showed marginally longer mean run lengths than 18-month-olds ($M = 1.69$, $SE = .11$).

Table 2 also shows mean number of contacts. To test for differences in the number of contacts between the real and replica objects, a 2×2 ANOVA was conducted with age (14, 18 months) as a between-subjects factor and condition (real, replica) as a within-subjects factor. For telephones–hairbrushes, only a main effect for age was found, $F(1, 30) = 7.06$, $p = .012$, partial $\eta^2 = .19$. For lemons–pears, no main effects or interactions were found, all Fs < 3.19, *ns*. Fourteen-month-olds ($M = 14.07$, $SE = 1.09$) showed a greater number of contacts than 18-month-olds ($M = 10.22$, $SE = .96$). Notably, the results revealed no significant main effects or interactions with condition, indicating that the number of contacts to real and replica objects did not differ.

Table 3
Mean (*SD*) number of appropriate and inappropriate actions.

Set	Condition	Appropriate	Inappropriate
Telephone–hairbrush			
14 months	Real	1.29 (1.68)	.43 (.76)
	Replica	2.14 (3.44)	.61 (1.58)
18 months	Real	.50 (1.25)	.06 (.24)
	Replica	.61 (1.58)	.06 (.24)
Lemon–pear			
14 months	Real	1.50 (2.77)	.0 (.00)
	Replica	1.92 (2.94)	.0 (.00)
18 months	Real	1.47 (2.65)	.00 (.00)
	Replica	1.59 (2.48)	.00 (.00)

Table 4
Percentages of children classified as categorizers.

		Categorizer	
		Single	Dual
Telephone–hairbrush			
14 months	Real	43	0
	Replica	64	7
18 months	Real	53	0
	Replica	78	6
Lemon–pear			
14 months	Real	36	21
	Replica	50	7
18 months	Real	33	0
	Replica	33	0

The sequential touching procedure allows infants to freely interact with the objects. Many of these actions are exploratory (touching, picking them up, throwing, and shifting objects from one hand to another). Given the objects used in this experiment, several (naturally occurring) actions can be considered as appropriate to a stimulus category. For example, mouthing is more appropriate for fruit than for telephones or brushes, and touching an object to the head is more appropriate for telephones and brushes than for fruit. In addition to recording the order of contacts, we coded the type of action. For fruit, appropriate actions were mouthing or eating and inappropriate actions were touching the fruit to the top or side of the head. For telephones and brushes, an appropriate action was touching the object to the side or top of the head and inappropriate actions were mouthing or eating. The overall number of instances of appropriate and inappropriate actions was low (see Table 3); most interactions with the objects were not specific to category membership.

To explore whether infants engaged in appropriate actions differently as a function of whether the objects were real or replicas, $2 \times 2 \times 2$ ANOVAs were conducted with age (14, 18 months) as a between-subjects factor and action type (appropriate, inappropriate) and condition (real, replica) as within-subjects factor. For telephones–hairbrushes, main effects for action type and age were found, $F(1, 30) = 7.43$, $p = .011$, partial $\eta^2 = .20$, and $F(1, 30) = 5.35$, $p = .028$, partial $\eta^2 = .15$, respectively. The main effect for action type was due to significantly more appropriate ($M = 1.14$, $SE = .31$) than inappropriate actions ($M = .26$, $SE = .12$). The main effect for age was due to significantly more actions by 14-month-olds ($M = 1.09$, $SE = .25$) compared to 18-month-olds ($M = .31$, $SE = .22$). For lemon–pears, only a main effect for action type was found, $F(1, 27) = 14.96$, $p = .001$, partial $\eta^2 = .34$, owing to significantly more appropriate ($M = 1.62$, $SE = .42$) than inappropriate actions ($M = .00$, $SE = .00$). Notably, for both telephones–hairbrushes and lemon–pears there were no main effects or interactions with condition. In summary, appropriateness of infants' actions did not differ for real and replica objects.

3.2. Categorizer classification

In addition to comparing differences in mean run length to real and replica sets, we classified each infant as a categorizer or not using the Monte Carlo procedure suggested by Mandler et al. (1987) and the look-up table provided by Dixon, Woodward, and Merry (1998; see also Arterberry, Bornstein, & Haynes, 2011). Classification was based on the total number of contacts, the longest run length for a category in a set, and whether infants touched at least three or four different exemplars from the same category in the set. Because a run of touching multiple unique entities in a row can happen by chance, especially when an infant makes many contacts, the Monte Carlo program determines the likelihood of occurrence of runs. The program computes how often categorizing runs occur in 10,000 random draws. Repetitions are allowed (excluding contacts to the same entity in immediate succession) as long as a run includes three or four unique entities. This technique estimates the probability of one or more categorizing runs occurring by chance, as a function of the total number of objects a child touches. The percentages of infants classified as single and dual categorizers are shown in Table 4. A single categorizer met the criteria for one category in the set but not for both. As with other categorization work, individual infants were identified as

categorizers with the lemon–pear sets, even though as a group their mean run length did not exceed chance (e.g., Bornstein & Arterberry, 2010).

4. Discussion

The main goal of this experiment was to compare infants' categorization performance in a sequential touching task using real objects versus replicas of them. No differences emerged in 14- and 18-month-olds' categorization when tested with real or replica objects. Infants also showed no significant differences in their numbers of contacts or in the actions they engaged in between real and replica objects. By contrast, category level exerted more control over infants' categorization, as infants categorized real and replica telephones and hairbrushes (a higher-level categorical distinction), but they did not categorize real or replica lemons and pears (a lower-level distinction).

Infants' mean run length did not differ when tested with real versus replica objects, nor did their level of engagement with the objects, as measured by the number of contacts. The main goal of the experiment was to determine whether infants categorize real objects and their replicas similarly, and our data support the conclusion that they do. This finding is especially relevant for interpreting conclusions from the 20 or so years of cognitive research that has relied on the sequential touching procedure, as researchers, for the most part, have used realistic replicas in this work (sees Rakison & Oakes, 2003, for a review). The findings of the present experiment confirm that it is reasonable to generalize conclusions based on mean run length from replicas to real-world objects.

The findings of this experiment suggest that infants categorize and interact with real and replica objects in similar ways. We do not know, however, whether, when infants are interacting with a replica, they are making a direct correspondence to its real world counterpart. It has been argued that a challenge to achieving insight into symbols is their "dual" nature (DeLoache, 1989, 1995; Langer, 1942; Saussaure, 1959). To understand the symbolic nature of a model requires simultaneously acknowledging both its physical existence and its symbolic aspect. The results of Tomasello et al. (1999) and Younger and her colleagues (Johnson, Younger, & Cuellar, 2005; Johnson, Younger, & Furrer, 2005) suggest that 18-month-olds may be limited in understanding this dual representation. In their studies, when shown a replica and asked to select a real-world object or a video of an action using an object that was similar to a replica, 18-month-olds did not perform very well. Our next studies address this follow-up question.

Mean run length exceeded chance for real hairbrushes and telephones and for replica hairbrushes and telephones, indicating that infants of both ages categorized both. In contrast, mean run length did not exceed chance for lemons and pears, regardless of whether real or replica exemplars were used. This latter finding suggests that 14- and 18-month-olds did not categorize these sets. This pattern of findings, namely infants categorize higher-level (telephones–hairbrushes) but not lower-level object sets (lemons–pears), is consistent with previous research. A number of studies have shown that by 14–18 months infants are able to categorize objects from superordinate or global categories, including balls–blocks, animals–vehicles, animals–furniture, kitchen–bathroom items, and fruit–furniture (Bornstein & Arterberry, 2010; Ellis & Oakes, 2006; Mandler and Bauer, 1988; Mandler et al., 1987; Pauen, 2002). At this same age, more subtle categorical distinctions, such as those at the basic level with low contrast, are more difficult to categorize. For example, infants of 14 and 18 months have shown little evidence of categorizing dogs–horses, cars–trucks, cars–motorcycles, lemons–apricots, couches–easy chairs (Bornstein & Arterberry, 2010; Mandler et al., 1991).

In summary, the present experiment has shown that infants interact with real objects and their replicas in the sequential touching procedure in similar ways. Despite likely continuing development in understanding that replicas are separate objects that and represent real-world objects, replicas appear to be appropriate stimuli to use in the sequential touching procedure to address questions of young infants' categorization.

References

Arterberry, M. E., Bornstein, M. H., & Haynes, O. M. (2011). Assessing categorization performance at the individual level: A comparison of Monte Carlo simulation and probability estimate model procedures. *Infant Behavior and Development: 34.*, 321–326. http://dx.doi.org/10.1016/j.infbeh.2011.02.003

Bornstein, M. H. (1984). A descriptive taxonomy of psychological categories used by infants. In C. Sophian (Ed.), *Origins of cognitive skills* (pp. 313–338). Hillsdale, NJ: Erlbaum.

Bornstein, M. H. (2006). On the significance of social relationships in the development of children's earliest symbolic play: An ecological perspective. In A. Gönçü, & S. Gaskins (Eds.), *Play and development: Evolutionary, sociocultural, and functional perspectives* (pp. 101–129). Mahwah, NJ: Erlbaum.

Bornstein, M. H., & Arterberry, M. E. (2010). The development of object categorization in young children: Hierarchical inclusiveness, age, perceptual attribute and group versus individual analyses. *Developmental Psychology: 46.*, 350–365.

Bornstein, M. H., Hahn, C.-S., Suwalsky, J. T. D., & Haynes, O. M. (2003). Socioeconomic status, parenting, and child development: The *Hollingshead Four-Factor Index of Social Status* and the *Socioeconomic Index of Occupations*. In M. H. Bornstein, & R. H. Bradley (Eds.), *Socioeconomic status, parenting, and child development* (pp. 29–82). Mahwah, NJ: Erlbaum.

DeLoache, J. S. (1989). Young children's understanding of the correspondence between a scale model and a larger space. *Cognitive Development: 4.*, 121–139. http://dx.doi.org/10.1016/0885-2014(89)90012-9

DeLoache, J. S. (1995). Early understanding and use of symbols: The model model. *Current Directions in Psychological Science: 4.*, 109–113. http://dx.doi.org/10.1111/1467-8721.ep10772408

DeLoache, J. S., Pierroutsakos, S. L., Uttal, D. H., Rosengren, K., & Gottlieb, A. (1998). Grasping the nature of pictures. *Psychological Science: 9.*, 205–210. http://dx.doi.org/10.1111/1467-9280.00039

DeLoache, J. S., Uttal, D. H., & Rosengren, K. S. (2004). Scale errors offer evidence for a perception–action dissociation early in life. *Science: 304.*, 1027–1029. http://dx.doi.org/10.1126/science.1093567

Dixon, W. E., Woodard, T., & Merry, M. S. (1998). TouchStat: A Monte Carlo program for calculating sequential touching probabilities. *Behavior Research Methods, Instruments, & Computers: 30.*, 592–604.

Ellis, A. E., & Oakes, L. M. (2006). Infants flexibly use different dimensions to categorize objects. *Developmental Psychology: 42.*, 1000–1011. http://dx.doi.org/10.1037/0012-1649.42.6.1000

Gibon, J. J. (1979). *The ecological approach to visual perception*. Boston: Houghton Mifflin.

Harnad, S. (Ed.). (1987). *Categorical perception: The groundwork of cognition*. New York City: Cambridge University Press.

Hollingshead, A. B. (1975). *Four factor index of social status*. New Haven, CT: Department of Sociology, Yale University. Unpublished manuscript.

Johnson, K. E., Younger, B. A., & Cuellar, R. E. (2005). Toddlers' understanding of iconic models: Cross-task comparison of selection and preferential looking responses. *Infancy: 8.*, 189–200. http://dx.doi.org/10.1207/s15327078in0802_5

Johnson, K. E., Younger, B. A., & Furrer, S. D. (2005). Infants' symbolic comprehension of actions modeled with toy replicas. *Developmental Science: 8.*, 299–318. http://dx.doi.org/10.1111/j. 1467-7687.2005.00416.x

Kovack-Lesh, K. A., & Oakes, L. M. (2007). Hold your horses: How exposure to different items influences infant categorization. *Journal of Experimental Child Psychology: 98.*, 69–93. http://dx.doi.org/10.1016/j.jecp.2007.05.001

Langer, S. K. (1942). *Philosophy in a new key*. Cambridge, MA: Harvard University Press.

Mandler, J. M., & Bauer, P. J. (1988). Kitchen things and bathroom things: The cradle of categorization: Is the basic level basic? *Cognitive Development: 3.*, 247–264.

Mandler, J. M., Bauer, P. J., & McDonough, L. (1991). Separating the sheep from the goats: Differentiating global categories. *Cognitive Psychology: 23.*, 263–298. http://dx.doi.org/10.1016/0010-0285(91)90011-C

Mandler, J. M., Fivush, R., & Reznick, J. S. (1987). The development of contextual categories. *Cognitive Development: 2.*, 339–354. http://dx.doi.org/10.1016/S0885-2014(87)80012-6

Mandler, J. M., & McDonough, L. (1993). Concept formation in infancy. *Cognitive Development: 8.*, 291–318. http://dx.doi.org/10.1016/S0885-2014(93)80003-C

Pauen, S. (2002). Evidence for knowledge-based category discrimination in infancy. *Child Development: 73.*, 1016–1033. http://dx.doi.org/10.1111/1467-8624.00454

Rakison, D. H., & Butterworth, G. E. (1998a). Infants' use of object parts in early categorization. *Developmental Psychology: 34.*, 49–62. http://dx.doi.org/10.1037/0012-1649.34.1.49

Rakison, D. H., & Butterworth, G. E. (1998b). Infants' attention to object structure in early categorization. *Developmental Psychology: 34.*, 1310–1325. http://dx.doi.org/10.1037/0012-1649.34.6.1310

Rakison, D. H., & Oakes. (2003). *Early category and concept development*. Oxford, UK: Oxford University Press.

Saussaure, F. D. (1959). (*Course in linguistics*) (W. Baskin, Trans.). New York: Philosophical Library.

Tamis-LeMonda, C. S., Užgiris, I., & Bornstein, M. H. (2002). Play in parent–child interactions. In M. H. Bornstein (Ed.), *Handbook of parenting. Vol. 5: Practical parenting*. Mahwah, NJ: Erlbaum, 2e, pp. 221–241.

Tomasello, M., Striano, T., & Rochat, P. (1999). Do young children use objects as symbols? *British Journal of Developmental Psychology: 17.*, 563–584.

Ware, E. A., Uttal, D. H., Wetter, E. K., & DeLoache, J. S. (2006). Young children make scale errors when playing with dolls. *Developmental Science: 9.*, 40–45. http://dx.doi.org/10.1111/j.1467-7687.2005.00461.x

Younger, B. A., & Johnson, K. E. (2004). Infants' comprehension of toy replicas as symbols for real objects. *Cognitive Psychology: 48.*, 207–242. http://dx.doi.org/10.1016/j.cogpsych.2003.07.001