Developmental Psychology
2014, Vol. 50, No. 3, 922–933

0012-1649/14/$12.00 DOI: 10.1037/a0034242

Social Context Effects in 2- and 4-Year-Olds' Selective Versus Faithful Imitation

Yue Yu and Tamar Kushnir
Cornell University

This study asked whether children's tendency to imitate selectively (ignore causally unnecessary actions) versus faithfully (*overimitate* causally unnecessary actions) varies across ages and social contexts. In the first experiment, 2-year-olds and 4-year-olds were randomly assigned to play 1 of 3 prior games with a demonstrator: a mimicry game, an instrumental game, or a noninteractive control game. They then participated in a puzzle-box imitation task in which the demonstrator performed 1 causally necessary and 1 unnecessary action to retrieve an object. Whereas 4-year-olds imitated faithfully across all conditions, 2-year-olds were more likely to imitate faithfully after a mimicry game and to imitate selectively after an instrumental game. Experiment 2 showed no effect of playing a mimicry game with a different experimenter prior to the imitation trials, thus ruling out 2-year-olds' faithful imitation being the result of motor priming or training effects. The results are discussed in terms of children's social affiliation and social–cognitive inferences.

Keywords: imitation, developmental differences, social cognition

Infants' and young children's imitation is at times selective and at times faithful. Starting from between age 7 and 14 months, infants demonstrate their understanding of others' goals by imitating selectively; they choose to copy intentional actions over actions that are performed accidentally or actions that are ambiguous in their goal (Carpenter, Akhtar, & Tomasello, 1998; Carpenter, Call, & Tomasello, 2002; Hamlin, Hallinan, & Woodward, 2008). Infants also select new actions that meet others' goals after being shown failed attempts at achieving them (Bellagamba, Camaioni, & Colonnesi, 2006; Meltzoff, 1995; Nielsen, 2009). Selective imitation can also demonstrate children's developing causal knowledge—children are often more likely to imitate causally relevant acts than irrelevant ones (Brugger, Lariviere, Mumme, & Bushnell, 2007; Buchsbaum, Gopnik, Griffiths, & Shafto, 2011; DiYanni & Kelemen, 2008; Williamson, Meltzoff, & Markman, 2008) or explore on their own when causal outcomes are ambiguous (Schulz, Hooppell, & Jenkins, 2008). A paradox arises, however, when children faithfully imitate actions that are both irrelevant to achieving goals and causally unnecessary. This tendency to faithfully imitate such actions is sometimes termed *overimitation* (Lyons, Young, & Keil, 2007) and has been shown across many studies using different methods and in a variety of contexts (Horner & Whiten, 2005; Kenward, Karlsson, & Persson, 2011; Lyons, Damrosch, Lin, Macris, & Keil, 2011; McGuigan, Makinson, & Whiten, 2011; McGuigan, Whiten, Flynn, & Horner, 2007; Nagell, Olguin, & Tomasello, 1993; Nielsen & Blank, 2011; Nielsen, Moore, & Mohamedally, 2012; Nielsen, Simcock, & Jenkins, 2008; Simpson & Riggs, 2011; Whiten, Custance, Gomez, Teixidor, & Bard, 1996).

Despite consensus that infants and young children demonstrate both selective and faithful imitation, there is little agreement about the conditions under which each takes place. At least one set of "conditions" noted is developmental—that is, there are observable age differences in imitative behavior (McGuigan & Whiten, 2009; Uzgiris, 1981). Studies that focus on infants tend to show selective imitation of actions necessary to accomplish goals (e.g., Brugger et al., 2007; Carpenter et al., 1998; Gergely, Bekkering, & Király, 2002; McGuigan & Whiten, 2009; Meltzoff, 1995; Zmyj, Daum, & Aschersleben, 2009), and studies that focus on preschoolers and older children tend to show faithful imitation of irrelevant actions even when goals are transparent (e.g., Horner & Whiten, 2005; Kenward et al., 2011; Lyons et al., 2007, 2011; McGuigan et al., 2007; Nielsen et al., 2008, 2012; Nielsen & Tomaselli, 2010; Whiten et al., 1996; for opposing evidence, see Bekkering, Wohlschlager, & Gattis, 2000; DiYanni & Kelemen, 2008; Want & Harris, 2001). These developmental differences have been the subject of recent empirical investigation, and though there is still much debate about how to best explain them, there is some consensus that both cognitive and social differences between ages play some role (McGuigan & Whiten, 2009; Whiten, McGuigan, Marshall-Pescini, & Hopper, 2009).

Another set of conditions leading to differences in imitative behavior is contextual. It has long been observed that social context accounts for differences in children's imitative behavior

This article was published Online First August 26, 2013.

Yue Yu and Tamar Kushnir, Department of Human Development, Cornell University.

This research was supported by National Science Foundation Developmental and Learning Sciences Grant 1023179 to Tamar Kushnir. We gratefully thank Sydney Beck, Katherine Braun, Shelby Distenfeld, Michelle Elsner, Sara Gager, Michael Johnson, Niki Klein, Nisha M. Patel, Alexis Ritter, Kimberly Senko, Sarah Suarez, Christopher Vredenburgh, and Katie Weidlein, for assistance with recruitment, testing, and coding. We thank all children, their parents, and their preschools for participation.

Correspondence concerning this article should be addressed to Yue Yu, Department of Human Development, Martha Van Rensselaer Hall, Cornell University, Ithaca, NY 14850. E-mail: yy376@cornell.edu

across situations (reviewed in Over & Carpenter, 2012, 2013). In one account, the driving force behind these social context effects is the motivation to affiliate (Meltzoff, 2007; Nielsen, Suddendorf, & Dissanayake, 2006; Tomasello, Carpenter, Call, Behne, & Moll, 2005; Uzgiris, 1981). This can be seen in studies where children are given the opportunity to socially engage with the demonstrator prior to or during imitation: for example, children imitate more faithfully when the demonstrator plays with them (Nielsen, 2006) or talks with them (Brugger et al., 2007) prior to the imitation task. They imitate more faithfully in response to live demonstrators rather than video (McGuigan et al., 2007; Nielsen et al., 2008) and in the presence of the specific individual demonstrator over new individuals (Király, 2009; Nielsen & Blank, 2011). In addition, the social affiliation account has also been used to explain *synchronic imitation*, in which toddlers copy behavior in concert with their play partner as a way to participate in the interaction (Asendorpf, Warkentin, & Baudonnière, 1996; Nielsen, Slaughter, & Dissanayake, 2013).

There is also another important way that social context influences imitation. This can be seen when children imitate—sometimes selectively and sometimes faithfully—based on their social–cognitive inferences about demonstrators' intentions and knowledge states. For example, both toddlers and preschoolers imitate more faithfully after pedagogical versus nonpedagogical demonstrations (Bonawitz et al., 2011; Brugger et al., 2007; Southgate, Chevallier, & Csibra, 2009). They are also more likely to imitate competent or knowledgeable demonstrators (Buchsbaum et al., 2011; DiYanni & Kelemen, 2008), as well as adult demonstrators (Wood, Kendal, & Flynn, 2012). It should be noted that just as children's affiliative motivations can be established before imitation begins, children may be sensitive to goals established prior to, as well as during, a demonstration (Carpenter et al., 2002).

Thus, in prior work, both age and social context have led to measurable differences in imitative behavior. We suggest that these differences are connected: as children's social–cognitive abilities develop and change with age, their interpretation of social context changes, leading to differences in the selectivity or faithfulness of imitation. Though this idea is appealing and consistent with previously found differences, it currently has no direct empirical support. For one thing, in imitation studies conducted with preschoolers, objects used are often more causally complex than those used in studies with infants and toddlers. Thus, potential developmental differences in children's interpretation of social context are confounded by the influence of other developmental changes in information processing ability and in causal knowledge (Gleissner, Bekkering, & Meltzoff, 2000; Jones, 2009; McShane, 1991; Sobel & Kirkham, 2006). Moreover, researchers in studies using direct manipulation of social context often tailor their methods toward the social–cognitive abilities at each age. For example, in studies conducted with preschoolers, a demonstrator's epistemic states or pedagogical intent are often explicitly stated verbally (e.g., "I don't know how to do it"; Wood et al., 2012). In studies of infants and toddlers, the cues are less explicitly verbal, but instead involve body language signaling intentions through actions in conjunction with joint attentional cues. Although tailoring social cues to particular ages is useful for figuring out the competencies at each age, it does not leave room for age-specific social–cognitive inferences to spontaneously influence imitative behavior.

In the current study, we aimed to directly investigate whether age and context combine to influence children's selective versus faithful imitation. To investigate the effects of age, we compared 2-year-olds with 4-year-olds using the same imitation task. We chose 2- and 4-year-olds because previous studies (McGuigan et al., 2007; McGuigan & Whiten, 2009) have suggested the most dramatic change in children's selective versus faithful imitation occurs roughly between these ages. When McGuigan and Whiten (2009) compared the imitative performance among children of 23, 30, 42, and 66 months old, the largest increase in fidelity of imitation occurred between the ages of 30 and 42 months. Therefore, by recruiting 2- and 4-year-olds, we could ask whether we would see analogous developmental changes in how children respond to differences in the immediate social context. To investigate the effects of social context, we set up different social contexts across groups of children by engaging in an activity with them *prior to* imitation that did not involve the stimuli used *during* imitation: These activities were equally engaging, thus encouraging affiliation with the demonstrator. However, they also involved different social goals, thus encouraging different social–cognitive inferences. Children at each age were randomly assigned to one of three social contexts, in the form of different "games." The first was a game in which children mimicked the hand gestures of the experimenter (*Copy-Me game*). Mimicry has been found to facilitate social interaction in adults (Chartrand & Bargh, 1999; Lakin & Chartrand, 2003; van Baaren, Holland, Kawakami, & van Knippenberg, 2004) and young children (Carpenter, Uebel, & Tomasello, in press). The second game involved finding and putting pieces in a puzzle (*Find-the-Piece game*). This game aimed to encourage children to work toward an instrumental goal (to solve a cognitive task) together with the experimenter. We also included a noninteractive (i.e., nonaffiliative) baseline condition in which the experimenter was present, but children drew a picture by themselves prior to the imitation task (*Drawing game*).

The imitation task we used was adapted from the "puzzle box" tasks, which are commonly used to measure both selective and faithful imitation (e.g., Brugger et al., 2007; Horner & Whiten, 2005; Kenward et al., 2011; Lyons et al., 2007; Nielsen, 2006; Simpson & Riggs, 2011). In this task, the demonstrator performs several actions on a box followed by an interesting result (usually the retrieval of an object from the box). Some actions are causally necessary for achieving the result, whereas others are causally unnecessary. Thus, children had a choice—to either imitate selectively (perform only causally necessary actions) or faithfully (perform all demonstrated actions).

By using the same objects for the imitation task across ages, we held constant both information processing demands and causal complexity. As stated earlier, previous studies have shown that when the causal properties of the puzzle box are complex or opaque, children are more likely to imitate faithfully as a conservative strategy that guarantees success (Bauer & Kleinknecht, 2002; Williamson & Markman, 2006). In our imitation task, we selected a set of puzzle boxes which in previous work (Brugger et al., 2007) were shown to be easy to operate and also causally transparent even to infants. We also included a set of trials in which the entire sequence of actions was causally necessary for achieving the result, to ensure that children could (and would) perform both actions when necessary.

Another factor held constant in the imitation tasks across all conditions was the use of pedagogical cues. The demonstrator's pedagogical cues before and during imitation (e.g., calling children's name, making eye contact with children) have been shown to reliably increase both infants' and preschoolers' tendency to imitate faithfully (Brugger et al., 2007; Nielsen, 2006; Southgate et al., 2009). In our imitation task, *all* demonstrated actions during the imitation task were performed with pedagogical cues. Thus, any differences found in imitation across conditions and age groups would be due to the effects of the social context set up prior to the imitation task.

Experiment 1

In Experiment 1, both 2-year-old and 4-year-old children completed the imitation task after they played one of the prior games with the same experimenter. Across contexts and ages, we expected to see differences in selective versus faithful imitation. To the extent that children are influenced by the social context to imitative faithfully, we expected that they would do so most after playing a mimicry game. To the extent that they are influenced by the social context to imitate selectively, we expected children would do so most after the instrumental game. In the absence of any information about social context (the baseline condition), we expected to replicate the different rates of faithful imitation found at each age in previous studies (i.e., higher rates in 4-year-olds than in 2-year-olds).

Method

Participants. Thirty-six 2-year-olds (M_{age} = 27.0 months, SD = 2.0 months; range = 23.3–33.1 months, 19 boys) and 36 4-year-olds (M_{age} = 53.1 months, SD = 3.5 months, range = 48.1–59.6 months, 19 boys) participated in the study. Two-year-olds were recruited from an infant database in a small university town. Five additional 2-year-olds were recruited but were not able to complete the whole task because of fussiness or distraction (two of these five children were originally assigned to the Copy-Me game, two to the Find-the-Piece game, and one to the Drawing game). According to parental report, 69% of the included 2-year-olds were White, and 97% of their mothers had a college degree or higher.[1] Four-year-olds were recruited from preschools in the same area and were similarly distributed along socioeconomic variables. An equal number of children (n = 12 at each age) were assigned to one of three games pseudo-randomly; there were no significant age differences between conditions, 2-year-olds: $F(2, 33) = 0.36$, *ns*; 4-year-olds: $F(2, 33) = 0.10$, *ns*.

Materials. Four different puzzle-box-type toys were used in the imitation game: the Box, the Ramp, and the Rake were adapted from Brugger et al. (2007), and the Birdhouse was our own design (see Figure 1). For the first three toys, each could be set up so that the first action (Action A) was either necessary for retrieving the object or unnecessary. Two birdhouses were constructed following the same logic, one in which Action A was necessary and one in which it was not. It is important to note that the causal properties of all toys were designed to be transparent to young children (see Brugger et al., 2007). The objects to be retrieved from inside the toys were eight puzzle pieces in the shape of animals, each with a roughly 2-in. diameter.

Procedure. Two-year-olds participated in a quiet lab playroom with their parent present after a short warm-up period with the experimenter and the parent outside the room. Four-year-olds participated in a quiet room at their preschool. The same male experimenter interviewed all of the children, and each session was videotaped. Each session contained three phases: familiarization, prior game condition, and imitation.

Familiarization. This phase was designed to ensure that children were familiar with the causal properties of all toys used in the imitation task. The experimenter sequentially showed children four empty toys (the Box, the Ramp, the Rake, and the Birdhouse) in the way they were set up in the Necessary trials. The order of the toys was counterbalanced across participants. For each toy, the experimenter said "Look! Have you seen this toy before? You can play with it," and pushed the toy to the child. Children played with each toy for up to 1 min. If they did not explore Actions A and B (see Figure 1) related to the toy before shifting attention away, the experimenter would point out the related parts on the toy and let children try these actions. Critically, the experimenter did not act on the toy himself during this phase.

Prior game conditions. Following familiarization, each child was randomly assigned to one of three games—the Copy-Me game, the Find-the-Piece game, or the Drawing game. We controlled the length of the three games to be about equal (1.5 min). To check that this standard was adhered to, we timed the length of the game for each child, and mean length was not different across conditions—Copy-Me: 93 s; Find-the-Piece: 91 s; Drawing: 103 s; $F(2, 66) = 1.04$, *ns*. We also matched the structure of the Copy-Me and Find-the-Piece games. For example, both games involved four events (four actions for Copy-Me and four puzzle pieces for Find-the-Piece), and children were praised in the same way either after they mimicked the action, or after they found a piece.

The Copy-Me game involved mimicking the hand gestures of the experimenter. The experimenter started by saying, "Let's play a game called 'Copy-Me.' I will do some actions, and you will follow me and do the same." Children copied a total of four actions, including "clap-slap" (alternately clapping hands and slapping hands on the table), "open shut" (alternately opening and shutting two hands), "rub hands" (rubbing hands slowly), and "flying" (crossing the thumbs of two hands and flapping the other fingers as a bird would flap wings).

The Find-the-Piece game involved establishing an instrumental goal. The experimenter placed a puzzle board with eight sockets on it (four mom animals, four baby animals) on the table. Four of the pieces (mom animals) were placed beside the board, and the other four (baby animals) were in the toy boxes and served as the pieces to be retrieved during imitation game. The experimenter named each mom animal in turn and took turns with the child in placing each animal back in the puzzle (e.g., "Let's help the mom elephant go back home!").

[1] Our sample mainly consisted of White children and children born from highly educated parents. Therefore, further research is needed to verify if our results can be generalized to children from other cultures and socioeconomic strata. However, it is heartening to see recent cross-cultural work confirm some of the imitation results from primarily Western samples (Callaghan et al., 2011; Nielsen & Tomaselli, 2010), which suggests the faithfulness and selectivity in children's imitation may be universal.

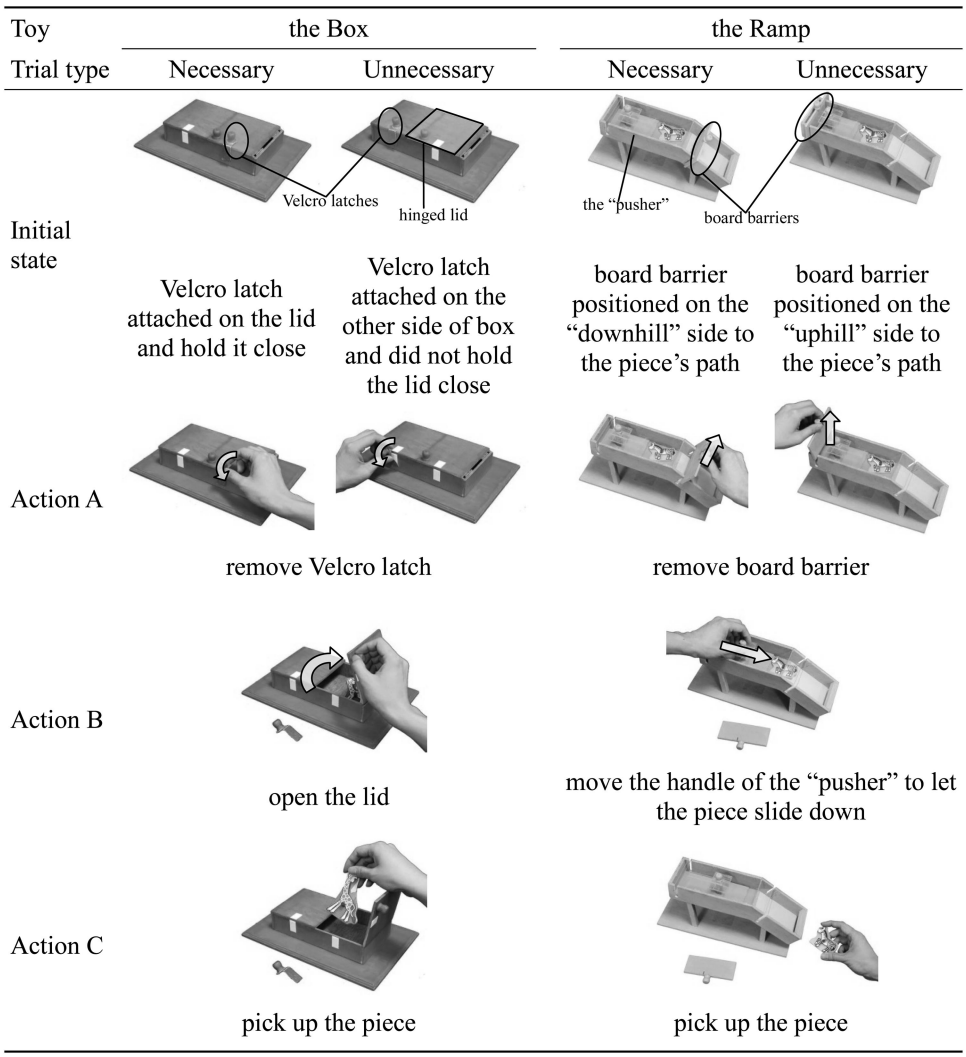

Figure 1. Toys and actions demonstrated in the imitation test. Each toy was set up so that the first action was either necessary or unnecessary. During the demonstration, the experimenter sequentially performed Actions A, B, and C in a slow, deliberate fashion.

The Drawing game served as a noninteractive control. The experimenter took out a crayon and a piece of paper, and said "Let's play a drawing game. You can draw whatever you want." He then gave children the crayon and paper to draw and did not interact with them during drawing.

Imitation task. Immediately after they had played the prior game, children participated in the imitation task. The imitation task comprised eight trials, four Necessary trials and four Unnecessary trials. Each child was assigned to one of two orderings (equally balanced across age groups and prior game conditions). The Necessary and Unnecessary trials always followed the order NUUNUNNU or UNNUNUUN, and the toy boxes' orders were counterbalanced so that each box that was N within the first four trials was a U in the first four trials for the next participant. Puzzle pieces followed one of two orderings following the same logic.

For each trial, the experimenter performed two actions (A and B) and then retrieved the puzzle piece (Action C; see Figure 1). He then removed the toy from view and placed the piece back inside. Then, he returned the toy to the table, saying, "Now your turn!" Each child was allowed to play with the toy until he or she had retrieved the piece or until 1 min had passed.[2]

As an addition to the procedure for the older children (4-year-olds, not 2-year-olds), at the end of the imitation game, we asked a *causal necessity* question about the last Unnecessary trial in which children imitated the unnecessary action (one child did not

[2] In previous studies, the number of demonstrations for each puzzle box ranged from one (e.g., Lyons et al., 2007), two (e.g., Brugger et al., 2007), three (e.g., Nielsen, 2006), to five (e.g., Horner & Whiten, 2005). In our study, there were relatively more trials (four Unnecessary and four Necessary) for each child than in the previous studies; therefore, to keep children's attention, the puzzle boxes were demonstrated only once. Given that most 2-year-olds and 4-year-olds imitated all demonstrated actions in the Necessary trials, we believe one demonstration was enough for them to remember and reproduce these actions.

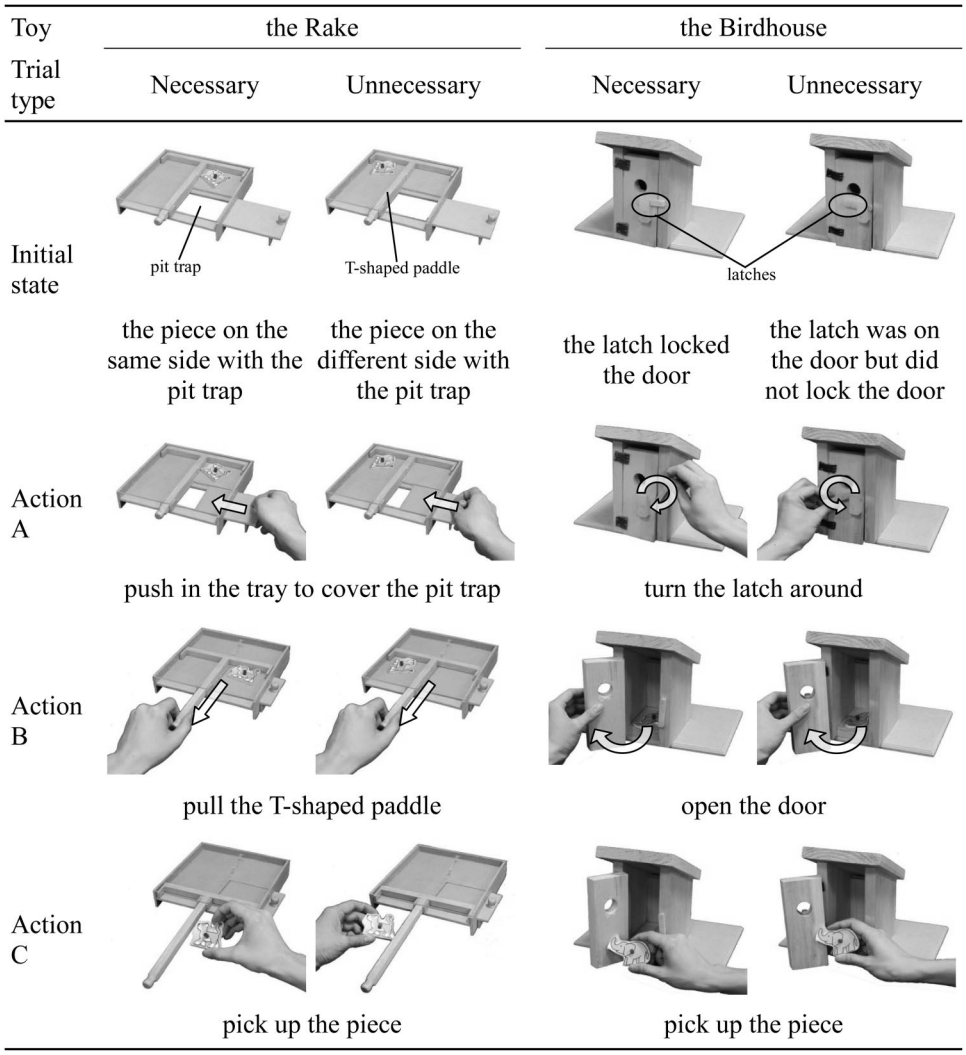

Figure 1 (*continued*).

copy any unnecessary actions at all, so she was asked about the box in her last Unnecessary trial). The question was, "Is it possible to get it out without doing this [demonstration of Action A]? How?" This procedure was inspired by the verbal measures used in Kenward et al.'s (2011) study.

Coding. All videos from the imitation tasks were coded by two hypothesis- and condition-blind research assistants. The coding scheme is detailed in Table 1. For each trial, the coders first recorded whether the child retrieved the puzzle piece. For those trials in which the piece was retrieved, retrieval time, individual actions, and imitative behavior were coded.

Imitative behavior was categorized as "A + B," "B only," or "Other." Actions coded as "A + B" involved performing both of the demonstrated actions in sequence and then retrieving the piece, with no additional actions. On the four Unnecessary trials, this represented faithful imitation of both causally necessary and unnecessary actions. Actions coded as "B only" involved performing only Action B followed by retrieving the piece.[3] Finally, "Other" actions included all actions that could not be characterized as "A + B" or "B only" but resulted in successful retrieval of the piece. Three typical responses in this category ranged from "reversal," "additional actions," and "own way" (for descriptions of each, see Table 1). Because these subcategories constituted a small proportion of total responses (28.7% for 2-year-olds and 7.3% for 4-year-olds), they were combined into one category. Interrater reliability statistics for all coding categories were high. For retrieval, Cohen's $\kappa = 0.84$ for the 2-year-olds and 1 for the 4-year-olds; for time of retrieval, interrater correlation $r = 0.95$ and 0.86; for individual actions, Cohen's $\kappa = 0.91$ and 0.97; for imitative behavior, Cohen's $\kappa = 0.80$ and 0.81.

For 4-year-olds, we also coded verbal and behavioral responses for the causal necessity question. Verbal response was coded as "Yes" or "No," and behavioral responses were coded in the same way as those during the imitation task.

[3] On the Necessary trials, the "B only" strategy was not available as it was not possible to perform Action B without performing Action A.

Table 1
Coding Scheme of Children's Performance in the Imitation Task

Item/code	Description
Retrieval	
0/1	Whether children retrieved the puzzle piece
Time for retrieval	
Time in seconds	Time period from children first touched the toy box to when they retrieved the puzzle piece
Individual actions	
A	Demonstrator's first action (see Figure 1)
B	Demonstrator's second action (see Figure 1)
C	Demonstrator's final action—pick up the piece
D	Actions with the toy box that had not been demonstrated, aiming at retrieving the piece (e.g., for the Rake, leaning and shaking the toy box to get the piece slide out)
E	Actions with the toy box that had not been demonstrated, not aiming at retrieving the piece (e.g., for the Ramp, putting back the barrier after pulling it out)
Imitative behavior	
"A + B"	Performing actions A, B, C in the exact order, no additional actions
"B only"[a]	Performing actions B, C in the exact order, no additional actions
"Other"	Any other way of retrieval, include three subcategories as listed below:
–Reversal[a]	Reversing the order of actions A and B (e.g., performing "B, A, C")
–Additional actions	Adding additional actions that were not demonstrated (e.g., performing "A, E, B, E, C"). The additional action needed to be distinctive; pausing during performing an action or accidentally touching other parts of the toy box did not qualify additional action
–Own way	Using a different way to retrieve the piece (e.g., performing "D, C")

[a] Only applicable to the Unnecessary trials.

Results

Across age group and prior game conditions, children were overwhelmingly successful at accomplishing the goal of the imitation trials (to retrieve the pieces from the puzzle boxes). Two-year-olds were able to retrieve the pieces for 96.9% of the total trials; 4-year-olds retrieved the pieces on 100% of the trials. Mean retrieval time was 10.7 s for 2-year-olds ($SD = 4.3$) and 7.6 s for 4-year-olds ($SD = 2.3$), and retrieval time did not differ across prior game conditions, $F(2, 138) = 2.03$, *ns*. On the Necessary trials, 4-year-olds overwhelmingly performed "A + B," with no differences between prior game conditions, Copy-Me: 89.6%; Find-the-Piece: 85.4%; Drawing: 81.3%, $F(2, 33) = 0.61$, *ns*. Two-year-olds also performed "A + B" in the majority of Necessary trials, again with no differences between prior game conditions, Copy-Me: 66.7%; Find-the-Piece: 66.0%; Drawing: 52.1%, $F(2, 33) = 1.68$, *ns*.[4] There was no effect of order on any of our dependent measures (including the number of successful retrievals, retrieval time, or imitative behavior; all ps $> .2$). Thus, results were combined across orders for all analyses.

Figure 2 shows the number of "A + B," "B only," and "Other" responses in the Unnecessary trials for each age group. Three 2 (age group: 2-year-olds vs. 4-year-olds) × 3 (prior game condition: Copy-Me, Find-the-Piece, Drawing) analyses of variance—one on each type of coded behavior—all revealed significant main effects of age group, "A + B": $F(1, 66) = 21.1$, $p < .001$, $\eta_p^2 = .24$; "B only": $F(1, 66) = 8.88$, $p = .004$, $\eta_p^2 = .12$; "Other": $F(1, 66) = 5.62$, $p = .02$, $\eta_p^2 = .08$. Two also showed significant interactions between age group and prior game condition, "A + B": $F(1, 66) = 4.17$, $p = .02$, $\eta_p^2 = .11$; "Other": $F(1, 66) = 4.56$, $p = .01$, $\eta_p^2 = .12$. To interpret these patterns, we examined the responses separately for each age group—first looking at the average use of each imitation strategy within each prior game condition and then looking at consistency of each behavior in individual children.

Group-level analysis of imitation strategies. Four-year-olds imitated faithfully across all conditions. That is, they imitated both the unnecessary action (Action A) and the necessary action (Action B) before retrieving the puzzle piece in most of the trials, and rates of faithful imitation did not differ across the prior game condition, Copy-Me: $M = 2.67$, $SD = 1.07$; Find-the-Piece: $M = 2.42$, $SD = 1.38$; Drawing: $M = 3.25$, $SD = 0.75$; $F(2, 33) = 1.82$, *ns*. Rates of selective imitation and other behaviors were low and did not differ across conditions either, "B only" responses: $F(2, 33) = 1.22$, *ns*; "Other" responses: $F(2, 33) = 1.21$, *ns*. This result parallels rates of overimitation found in previous studies (e.g., McGuigan et al., 2007).

Two-year-olds, on the other hand, used very different imitation strategies depending on the game played prior to the imitation task. Rates of faithful imitation ("A + B" responses) on Unnecessary trials were significantly different depending on the prior game condition, $F(2, 33) = 5.90$, $p = .006$, $\eta^2 = 0.26$. Two-year-olds were significantly more likely to imitate faithfully after the Copy-Me game than after the Find-the-Piece game or the Drawing game, Copy-Me vs. Find-the-piece: $t(22) = 2.81$, $p = .01$, $d = 1.16$; Copy-Me vs. Drawing: $t(22) = 3.15$, $p = .005$, $d = 1.30$. Rates of selective imitation ("B only" responses) also varied across prior game conditions, $F(2, 33) = 2.69$, $p = .05$, $\eta^2 = 0.16$. Two-year-olds were more likely to imitate selectively after playing the Find-the-Piece game than the Copy-Me game, $t(22) = 2.56$, $p = .02$, $d = 1.05$. Finally, rates of "Other" responses varied as well, $F(2, 33) = 4.29$, $p = .02$, $\eta^2 = 0.21$. Two-year-olds were

[4] "A + B" performance of Necessary trials was lower in 2-year-olds mainly because they were more likely to add additional actions into the demonstrated action sequence (for "Other–additional action," 2-year-olds' mean: 14.1%; 4-year-olds' mean: 0%; $t(70) = 3.99$, $p < .001$). Occurrence of "Other–additional action" was much lower in the Unnecessary trials and did not differ with age group (2-year-olds' mean: 3.5%; 4-year-olds' mean: 3.5%).

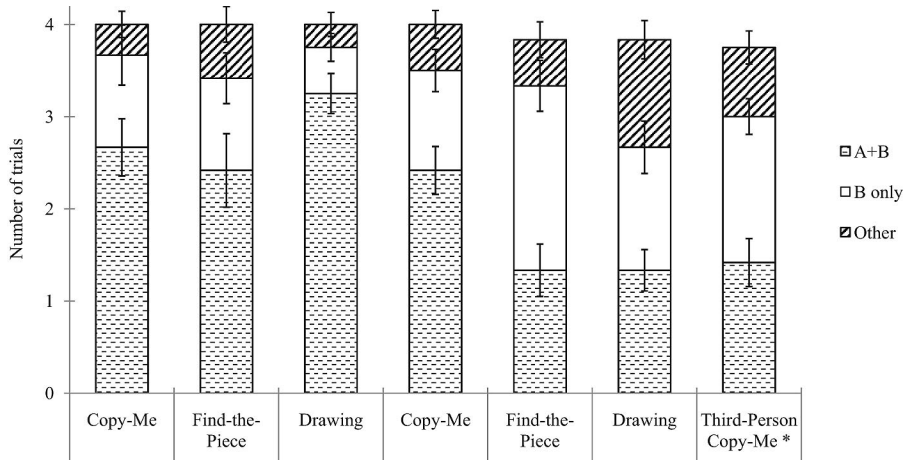

Figure 2. Children's imitative behavior in the Unnecessary trials. Four-year-old children predominantly performed "A + B" across all conditions. The response of 2-year-olds were more variable across conditions, and the only condition they predominantly performed "A + B" was after the "Copy-Me" game. *The Third-Person Copy-Me condition is from Experiment 2; all the other conditions are from Experiment 1.

more likely to perform "Other" responses after the Drawing game than the Copy-Me or Find-the-Piece games, Drawing vs. Copy-Me: $t(22) = 2.60$, $p = .02$, $d = 1.07$; Drawing vs. Find-the-Piece: $t(22) = 2.35$, $p = .03$, $d = 0.96$.

Individual-level analysis of imitation strategies. To examine consistency in individual children's responses, we categorized children according to their predominant imitative behavior on the Unnecessary trials (Table 2). Children were categorized as using a certain predominant strategy if they performed that strategy for at least 75% (3 out of 4) of such trials. This resulted in three groups of "consistent" children ("A + B," "B only," "Other") and a fourth group of inconsistent children (i.e., those with no predominant strategy). In line with findings from previous studies (McGuigan et al., 2007; McGuigan & Whiten, 2009), 4-year-olds were more consistent than 2-year-olds, whose behavior was more inconsistent, $\chi^2(1) = 12.5$, $p < .001$.[5] An analysis of the 4-year-olds who used one strategy consistently shows that they were overwhelmingly likely to use faithful imitation as predominant strategy, $\chi^2(2) = 34.8$, $p < .001$, and this tendency was independent of game, Fisher's exact $p > .3$.[6] These results reinforced the group-level analysis discussed earlier. On the other hand, although only one third of 2-year-olds used one strategy consistently, there was more consistency in the interactive conditions (Copy-Me and Find-the-Piece) than in the baseline condition (Copy-Me and Find-the-Piece combined: 10/24; Drawing: 1/11; Fisher's exact $p = .059$). When we focus on these consistent children, we find that their predominant strategy ("A + B," "B only" or "Other") depended on the game (Fisher's exact $p = .006$)—more of these children consistently used the "A + B" strategy after the Copy-Me game; more used the "B only" strategy after the Find-the-Piece game; the interaction effect was significant, Fisher's exact $p = .03$.

Follow-up question assessing 4-year-olds' causal understanding. Given that 4-year-olds tended to faithfully imitate regardless of the game, we looked for evidence of causal understanding in their explicit responses to the causal necessity question. When asked whether they could have retrieved the piece without performing Action A, 91.7% of 4-year-olds (33 out of 36) showed in some way that they understood that Action A was unnecessary—75% of children answered "Yes," and when asked "How?" they performed the "B only" solution; an additional 16.7% children performed the "B only" solution without giving a verbal answer. Two children (5.6%) said "Yes" but then performed "A + B." Only one child answered "No," and she followed her answer with "B only" response. These results converged with the results of Kenward et al. (2011), which showed that most 5-year-olds did not verbally report the unnecessary actions as necessary, especially when the apparatus was simple. Therefore, 4-year-olds' tendency to imitate faithfully in our imitation task could not be attributed to their misunderstanding of unnecessary actions as causally necessary.

Discussion

The results of Experiment 1 can be summarized as follows: At baseline, 4-year-olds were more likely to imitate faithfully than 2-year-olds, consistent with prior work (McGuigan et al., 2007; McGuigan & Whiten, 2009). However, 2-year-olds' imitation was influenced by the social context in which the imitation task was embedded. After playing an unrelated mimicry game with the experimenter, 2-year-olds were more likely to faithfully imitate causally unnecessary actions and in fact did so as much as 4-year-olds. However, after playing a game emphasizing an instrumental goal, 2-year-olds were more likely to selectively copy only the causally necessary actions. Thus, after the instrumental game, their imitation differed from the mimicry game, from baseline, and from the 4-year-olds who played the same instrumental game but still imitated faithfully at high rates. Analysis on individual level reinforced the observation that 2-year-olds performed flexibly across contexts and inconsistently across trials, whereas 4-year-olds performed faithful imitation consistently both across contexts and across trials.

[5] Chi-square test with Yates's continuity correction.
[6] Freeman–Halton extension of Fisher's exact test.

Table 2
Number of Children Who Used a Predominant Strategy in Unnecessary Trials

	4-year-olds			2-year-olds			
Action	Copy-Me	Find-the-Piece	Drawing	Copy-Me	Find-the-Piece	Drawing	Third-Person Copy-Me[a]
"A + B"	7	7	10	6	1	0	1
"B only"	2	1	0	0	3	0	1
"Other"	0	0	0	0	0	1	0
No dominant strategy	3	4	2	6	8	11	10

Note. Predominant strategy is defined as the imitative behavior they performed in three or more trials out of the four trials.
[a] The Third-Person Copy-Me condition is from Experiment 2; all the other conditions are from Experiment 1.

Since the materials and procedures used in the imitation task were identical for 2-year-olds and 4-year-olds, the age differences cannot be attributed to task complexity or procedural differences. Also, given that 2-year-olds did copy all actions in Necessary trials regardless of prior game, it is unlikely that information processing limitations such as short attention span or lack of memory capacity can account for differences in their imitative behavior in the Unnecessary trials.

Instead, the differences in 2-year-olds' imitative behavior can be best understood as their sensitivity to the differences in social context. Specifically, both the mimicry and the instrumental games involved more social interaction than the noninteractive drawing game, and thus led to higher rates of either faithful or selective imitation and lower rates of "Other" (more exploratory) responses. Critically, the *nature*, and not just the amount, of social interaction also influenced imitative behavior: depending on the prior intentions of the demonstrator, it either led toddlers to be more faithful or more selective. Thus, we suggest that 2-year-olds' behavior is best explained by a combination of affiliation and social–cognitive inference. It is likely that 2-year-olds used the prior game to help them infer the demonstrator's overarching goal—his intention to play a particular game throughout the entire lab session. Toddlers playing the mimicry game inferred the demonstrator intended them to mimic throughout the session, whereas toddlers playing the instrumental game inferred the demonstrator was trying to find the puzzle pieces together with them. Their imitative response can be explained as a motivation to fulfill this overarching goal.

One less interesting possibility, however, is that 2-year-olds' faithful imitation after the mimicry game was not based on a social–cognitive inference, but rather that the prior game simply "primed" or trained toddlers to copy actions. The motor priming effect (i.e., the effect of previous actions on current action plans) have been documented in 2-year-olds' reaching behavior (Spencer, Smith, & Thelen, 2001; Zelazo, Frye, & Rapus, 1996). In our mimicry game, 2-year-olds may be similarly primed to perform arbitrary gestures, leading to increased performance of unnecessary actions in the imitation task. It is also possible that because children were encouraged every time they copied an action in the mimicry game, they may continue to copy the exact actions in the imitation task in expectation of further reward. Experiment 2 was designed to rule out these explanations.

Experiment 2

To investigate whether 2-year-olds were trained or primed to imitate unnecessary actions after the mimicry game, we tested the same mimicry condition but with a separate experimenter for each part of the task—one for mimicry and one for imitation. If children's faithful imitation was mainly due to their persistent performance of a trained or primed response, we would expect that they would continue to imitate faithfully in this Third-Person Copy-Me condition. If they do not, then it would indicate that children in the mimicry condition of Experiment 1 were responding to the specific individual (for similar findings, see Henderson & Graham, 2005). This would be consistent with our hypothesis that toddlers make a social inference about the overarching goal of the demonstrator to play a single mimicry game throughout the session.

Method

Participants. Twelve 2-year-olds (M_{age} = 26.3 months, SD = 2.3 months; range = 24.0–30.3 months, seven boys) were recruited from the same infant database as in Experiment 1. Four additional children were recruited but were not able to complete the whole task because of fussiness or distraction. There were no significant age differences between these 2-year-olds and 2-year-olds in the Experiment 1, $F(3, 44) = 0.53$, *ns*. Demographic features of these children (75% White, 100% of their mothers had a college degree or higher) also resembled those of children in Experiment 1.

Procedure. Besides the experimenter who administrated Experiment 1 (E1), we added another experimenter (E2) in Experiment 2. All materials and tasks were identical to those in Experiment 1—each child sequentially completed the familiarization, Copy-Me game, and imitation task. Both E1 and E2 warmed-up with the child before the experiment. E2 then led the child into the playroom and showed him or her the empty toy boxes (familiarization). Then E1 walked in and played the Copy-Me game with the child, while E2 stayed at a corner of the room outside the child's sight. After the Copy-Me game, E2 administrated the imitation task to the child, during which E1 was outside the room. E2 was trained to administrate the familiarization and imitation tasks in the same way as E1 did in Experiment 1. E1 played the Copy-Me game in the exact same way as he did in Experiment 1. Coding of the length of Copy-Me games showed no difference between Experiments 1 and 2, $t(22) = 0.21$, *ns*.

Coding. Two hypothesis-blind research assistants coded children's responses following the same coding scheme as in Exper-

iment 1. Cohen's $\kappa = 1$ for retrieval, 0.94 for individual actions, and 0.91 for imitative behavior. Interrater correlation $r = .94$ for time of retrieval.

Results

Two-year-olds who played the Third-Person Copy-Me game in Experiment 2 did not differ from 2-year-olds who played the Copy-Me, Find-the-Piece, or Drawing games in Experiment 1 in number of successful retrievals, $F(3, 44) = 1.44$, *ns*, or mean retrieval time, $F(3, 44) = 0.97$, *ns*. For the Unnecessary trials (Figure 2), 2-year-olds in Experiment 2 performed more "B only" responses than "Other" responses, $t(11) = 3.08$, $p = .01$, $d = 0.89$; their "A + B" responses were not significantly different from "B only" or "Other" responses. It is important to note that these children performed significantly fewer "A + B" responses and slightly more "B only" responses than those who played Copy-Me game in Experiment 1, "A + B": $t(22) = 2.72$, $p = .01$, $d = 1.11$; "B only": $t(22) = 1.67$, $p = .11$, $d = 0.68$. The responses after Third-Person Copy-Me game were in fact more similar to the responses after the Find-the-Piece or Drawing games ($ps > .1$ for all three types of responses). Analysis of individual-level responses (Table 1) showed that the majority (10 out of 12) of children who played the Third-Person Copy-Me game did not show a dominant imitative strategy, which resembled children who played the Drawing game.

Discussion

In Experiment 2, we replicated the Copy-Me condition with a critical change: after one experimenter played the mimicry game with 2-year-olds, a different experimenter demonstrated the actions in the imitation task. Results showed that this manipulation changed 2-year-olds' imitative behavior: they were equally likely to imitate faithfully or selectively, and their responses were different from the children who played the mimicry game and imitation task with the same individual demonstrator in Experiment 1. These results ruled out the possibility that children imitated faithfully after the mimicry game in Experiment 1 purely due to being primed or trained to perform nonmeaningful actions. Instead, these results showed that the effect of mimicry game was specific to the particular demonstrator and suggested that 2-year-olds infer that the goals of the demonstrator transfer from one game to the next.

General Discussion

We began this study with the idea that as children age, differences in their interpretation of social context lead to differences in their selectivity or faithfulness of imitation. We attempted to offer direct evidence for this idea by examining 2- and 4-year-olds' imitative behavior using the same simple puzzle-box imitation task under three different social contexts. The results showed that whereas 4-year-olds faithfully imitated all actions regardless of the games played prior to imitation, 2-year-olds were heavily influenced by context set up by the prior game. They were more likely to faithfully imitate causally unnecessary actions after having previously played an unrelated mimicry game with the experimenter. They were more likely to selectively emulate the goals of the demonstrator after playing a game emphasizing an instrumental goal. They were also more likely to explore other means of retrieving the pieces after the noninteractive task of drawing pictures by themselves. Furthermore, their faithful imitation after the mimicry game could not be attributed to motor priming or training effects because they were less likely to imitate faithfully when a different experimenter administrated the imitation task.

Our results highlight how social context can have a very different effect on children's imitation depending on their age. As this initial demonstration suggests, 2- and 4-year-olds respond very differently to the same social cues. We believe that developmental differences in children's understanding of and interpretation of social situations are responsible for these differences. However, questions about the nature of these differences—in particular, why 2-year-olds behaved so differently in the three conditions and 4-year-olds' behavior was so remarkably consistent—remain to be explored in future work.

As for 2-year-olds, their imitative behavior was different based on the nature of the prior social interaction. Two of our results highlight the important role of social affiliation in children's responses: (a) the contrast between both interactive games in Experiment 1 and the baseline Drawing game on the rate of imitative versus "other" responses, and (b) the contrast between the mimicry conditions in Experiment 1 and Experiment 2 showed that faithful imitative responses were specific to a particular demonstrator, not the result of motor priming. A third result—that toddlers were more faithful or more selective based on the prior game they played, highlights the equally important role of their social–cognitive inferences in determining their imitative behavior. Together, these results suggest a need to elaborate on the affiliative account of imitation to include social cognition: as part of their desire to affiliate, toddlers may be motivated also to learn (and follow) the overarching goal that encompasses the entire social interaction.

What about 4-year-olds? Both previous studies and our study suggest that preschoolers imitate any purposeful action, largely independently from the particular context (Lyons et al., 2007, 2011; Nielsen et al., 2012). One explanation previously proposed to account for faithful imitation (overimitation) in preschoolers is that they erroneously encode unnecessary actions as causally necessary to retrieving the goal object (Lyons et al., 2007, 2011). A similar account suggests children may assume by default that all purposeful actions of adults—no matter if they appear necessary or unnecessary—reflect certain hidden causality of the apparatus, and thus children adopt a "copy-all, correct later" strategy (Horner & Whiten, 2005; Whiten et al., 2009). These explanations are unlikely to account for 4-year-olds' performance in our experiment, given that the objects we used were simple and causally transparent, and even infants understand the causal properties of these objects (Brugger et al., 2007). These explanations are further underscored by 4-year-olds' answers to the follow-up questions, which indicated that they understood the mechanism governing the boxes.

Another explanation supported by previous empirical work suggested that children may imitate as a way of learning about social or cultural norms, and therefore all purposeful actions (in particular actions demonstrated pedagogically) could be potentially useful in learning the rules and conventions of society (Csibra & Gergely, 2005; Diesendruck & Markson, 2011). Research has shown that starting from 2–3 years old, children become increas-

ingly sensitive to the normative structure of artifact functions (Casler, Terziyan, & Greene, 2009; Wohlgelernter, Diesendruck, & Markson, 2010), conventional activities (Rakoczy, 2008; Rakoczy, Warneken, & Tomasello, 2008; Schmidt, Rakoczy, & Tomasello, 2011) and language (Beller, 2010; Cummins, 1996; Harris & Núntez, 1996). Along this line, the increase of faithful imitation between toddlers and preschoolers may be due to an increasing tendency to view the intentionally demonstrated unnecessary actions as normative (Kenward, 2012; Kenward et al., 2011). Alternatively, it is also possible that increasing focus on the social function of imitation (i.e., increased affiliative motivation) leads to developmental changes in imitative behavior (Uzgiris, 1981). Further study is required to clarify whether the age difference we observed is driven by a desire to affiliate, by an inference that the demonstrator is intentionally teaching rules or norms, or by some combination of the two.

Recent studies (e.g., Flynn & Whiten, 2012) have started to connect children's peer imitation with various cognitive and social predictors. Studies of this kind will also benefit researchers' understanding of developmental differences in selective versus faithful imitation. We are currently exploring the cognitive and social correlates of these differences using a longitudinal method. Thus, we can directly ask whether developmental changes in children's social cognition play a central role. Whatever the explanation for these differences turns out to be, it is important to emphasize that the variation in imitative behavior—across situations, across development, and between individual children—is as important as similarities. This variation suggests that children are active interpreters of social information—trying to figure out when to imitate and what to imitate, and using their understanding of the social context to do so.

References

Asendorpf, J. B., Warkentin, V., & Baudonnière, P. M. (1996). Self-awareness and other-awareness II: Mirror self-recognition, social contingency awareness, and synchronic imitation. *Developmental Psychology, 32,* 313–321. doi:10.1037/0012-1649.32.2.313

Bauer, P. J., & Kleinknecht, E. E. (2002). To "ape" or to emulate? Young children's use of both strategies in a single study. *Developmental Science, 5,* 18–20. doi:10.1111/1467-7687.00197

Bekkering, H., Wohlschlager, A., & Gattis, M. (2000). Imitation of gestures in children is goal-directed. *Quarterly Journal of Experimental Psychology: Section A, 53,* 153–164. doi:10.1080/027249800390718

Bellagamba, F., Camaioni, L., & Colonnesi, C. (2006). Change in children's understanding of others' intentional actions. *Developmental Science, 9,* 182–188. doi:10.1111/j.1467-7687.2006.00478.x

Beller, S. (2010). Deontic reasoning reviewed: Psychological questions, empirical findings, and current theories. *Cognitive Processing, 11,* 123–132. doi:10.1007/s10339-009-0265-z

Bonawitz, E., Shafto, P., Gweon, H., Goodman, N. D., Spelke, E., & Schulz, L. (2011). The double-edged sword of pedagogy: Instruction limits spontaneous exploration and discovery. *Cognition, 120,* 322–330. doi:10.1016/j.cognition.2010.10.001

Brugger, A., Lariviere, L. A., Mumme, D. L., & Bushnell, E. W. (2007). Doing the right thing: Infants' selection of actions to imitate from observed event sequences. *Child Development, 78,* 806–824. doi:10.1111/j.1467-8624.2007.01034.x

Buchsbaum, D., Gopnik, A., Griffiths, T. L., & Shafto, P. (2011). Children's imitation of causal action sequences is influenced by statistical and pedagogical evidence. *Cognition, 120,* 331–340. doi:10.1016/j.cognition.2010.12.001

Callaghan, T., Moll, H., Rakoczy, H., Warneken, F., Liszkowski, U., Behne, T., & Tomasello, M. (2011). Early social cognition in three cultural contexts. *Monographs of the Society for Research in Child Development, 76*(2), vii–142. doi:10.1111/j.1540-5834.2011.00603.x

Carpenter, M., Akhtar, N., & Tomasello, M. (1998). Fourteen- through 18-month-old infants differentially imitate intentional and accidental actions. *Infant Behavior & Development, 21,* 315–330. doi:10.1016/S0163-6383(98)90009-1

Carpenter, M., Call, J., & Tomasello, M. (2002). Understanding "prior intentions" enables two-year-olds to imitatively learn a complex task. *Child Development, 73,* 1431–1441. doi:10.1111/1467-8624.00481

Carpenter, M., Uebel, J., & Tomasello, M. (in press). Being mimicked increases prosocial behavior in 18-month-old Infants. *Child Development*. doi:10.1111/cdev.12083

Casler, K., Terziyan, T., & Greene, K. (2009). Toddlers view artifact function normatively. *Cognitive Development, 24,* 240–247. doi:10.1016/j.cogdev.2009.03.005

Chartrand, T. L., & Bargh, J. A. (1999). The chameleon effect: The perception–behavior link and social interaction. *Journal of Personality and Social Psychology, 76,* 893–910. doi:10.1037/0022-3514.76.6.893

Csibra, G., & Gergely, G. (2005). Social learning and social cognition: The case for pedagogy. In Y. Munakata & M. Johnson (Eds.), *Attention and performance XXI: Processes of change in brain and cognitive development* (pp. 249–274). New York, NY: Oxford University Press.

Cummins, D. D. (1996). Evidence of deontic reasoning in 3- and 4-year-old children. *Memory & Cognition, 24,* 823–829. doi:10.3758/BF03201105

Diesendruck, G., & Markson, L. (2011). Children's assumption of the conventionality of culture. *Child Development Perspectives, 5,* 189–195. doi:10.1111/j.1750-8606.2010.00156.x

DiYanni, C., & Kelemen, D. (2008). Using a bad tool with good intention: Young children's imitation of adults' questionable choices. *Journal of Experimental Child Psychology, 101,* 241–261. doi:10.1016/j.jecp.2008.05.002

Flynn, E., & Whiten, A. (2012). Experimental "microcultures" in young children: Identifying biographic, cognitive, and social predictors of information transmission. *Child Development, 83,* 911–925. doi:10.1111/j.1467-8624.2012.01747.x

Gergely, G., Bekkering, H., & Király, I. (2002, February 14). Rational imitation in preverbal infants. *Nature, 415,* 755. doi:10.1038/415755a

Gleissner, B., Bekkering, H., & Meltzoff, A. N. (2000). Children's coding of human action: Cognitive factors influencing imitation in 3-year-old. *Developmental Science, 3,* 405–414. doi:10.1111/1467-7687.00135

Hamlin, J. K., Hallinan, E. V., & Woodward, A. L. (2008). Do as I do: 7-month-old infants selectively reproduce others' goals. *Developmental Science, 11,* 487–494. doi:10.1111/j.1467-7687.2008.00694.x

Harris, P. L., & Núntez, M. (1996). Understanding of permission rules by preschool children. *Child Development, 67,* 1572–1591. doi:10.2307/1131719

Henderson, A. M. E., & Graham, S. A. (2005). Two-year-olds' appreciation of the shared nature of novel object labels. *Journal of Cognition and Development, 6,* 381–402. doi:10.1207/s15327647jcd0603_4

Horner, V., & Whiten, A. (2005). Causal knowledge and imitation/emulation switching in chimpanzees (*Pan troglodytes*) and children (*Homo sapiens*). *Animal Cognition, 8,* 164–181. doi:10.1007/s10071-004-0239-6

Jones, S. S. (2009). The development of imitation in infancy. *Philosophical Transactions of the Royal Society B: Biological Sciences, 364,* 2325–2335. doi:10.1098/rstb.2009.0045

Kenward, B. (2012). Over-imitating preschoolers believe unnecessary actions are normative and enforce their performance by a third party. *Journal of Experimental Child Psychology, 112,* 195–207. doi:10.1016/j.jecp.2012.02.006

Kenward, B., Karlsson, M., & Persson, J. (2011). Over-imitation is better explained by norm learning than by distorted causal learning. *Proceedings of the Royal Society B: Biological Sciences, 278,* 1239–1246. doi:10.1098/rspb.2010.1399

Király, I. (2009). The effect of the model's presence and of negative evidence on infants' selective imitation. *Journal of Experimental Child Psychology, 102,* 14–25. doi:10.1016/j.jecp.2008.06.003

Lakin, J. L., & Chartrand, T. L. (2003). Using nonconscious behavioral mimicry to create affiliation and rapport. *Psychological Science, 14,* 334–339. doi:10.1111/1467-9280.14481

Lyons, D., Damrosch, D., Lin, J., Macris, D., & Keil, F. (2011). The scope and limits of overimitation in the transmission of artefact culture. *Philosophical Transactions of the Royal Society B: Biological Sciences, 366,* 1158–1167. doi:10.1098/rstb.2010.0335

Lyons, D., Young, A., & Keil, F. (2007). The hidden structure of overimitation. *Proceedings of the National Academy of Sciences of the USA, 104,* 19751–19756. doi:10.1073/pnas.0704452104

McGuigan, N., Makinson, J., & Whiten, A. (2011). From over-imitation to super-copying: Adults imitate causally irrelevant aspects of tool use with higher fidelity than young children. *British Journal of Psychology, 102,* 1–18. doi:10.1348/000712610X493115

McGuigan, N., & Whiten, A. (2009). Emulation and "overemulation" in the social learning of causally opaque versus causally transparent tool use by 23- and 30-month-olds. *Journal of Experimental Child Psychology, 104,* 367–381. doi:10.1016/j.jecp.2009.07.001

McGuigan, N., Whiten, A., Flynn, E., & Horner, V. (2007). Imitation of causally opaque versus causally transparent tool use by 3- and 5-year-old children. *Cognitive Development, 22,* 353–364. doi:10.1016/j.cogdev.2007.01.001

McShane, J. (1991). *Cognitive development: An information processing approach*. Oxford, England: Blackwell.

Meltzoff, A. N. (1995). Understanding the intentions of others: Re-enactment of intended acts by 18-month-old children. *Developmental Psychology, 31,* 838–850. doi:10.1037/0012-1649.31.5.838

Meltzoff, A. N. (2007). "Like me": A foundation for social cognition. *Developmental Science, 10,* 126–134. doi:10.1111/j.1467-7687.2007.00574.x

Nagell, K., Olguin, R. S., & Tomasello, M. (1993). Processes of social learning in the tool use of chimpanzees (*Pan troglodytes*) and human children (*Homo sapiens*). *Journal of Comparative Psychology, 107,* 174–186. doi:10.1037/0735-7036.107.2.174

Nielsen, M. (2006). Copying actions and copying outcomes: Social learning through the second year. *Developmental Psychology, 42,* 555–565. doi:10.1037/0012-1649.42.3.555

Nielsen, M. (2009). 12-month-olds produce others' intended but unfulfilled acts. *Infancy, 14,* 377–389. doi:10.1080/15250000902840003

Nielsen, M., & Blank, C. (2011). Imitation in young children: When who gets copied is more important than what gets copied. *Developmental Psychology, 47,* 1050–1053. doi:10.1037/a0023866

Nielsen, M., Moore, C., & Mohamedally, J. (2012). Young children overimitate in third-party contexts. *Journal of Experimental Child Psychology, 112,* 73–83. doi:10.1016/j.jecp.2012.01.001

Nielsen, M., Simcock, G., & Jenkins, L. (2008). The effect of social engagement on 24-month-olds' imitation from live and televised models. *Developmental Science, 11,* 722–731. doi:10.1111/j.1467-7687.2008.00722.x

Nielsen, M., Slaughter, V., & Dissanayake, C. (2013). Object-directed imitation in children with high-functioning autism: Testing the social motivation hypothesis. *Autism Research, 6,* 23–32. doi:10.1002/aur.1261

Nielsen, M., Suddendorf, T., & Dissanayake, C. (2006). Imitation and self-recognition in autism. In S. J. Rogers & J. H. G. Williams (Eds.), *Imitation and the development of the social mind: Autism and typical development* (pp. 138–156). New York, NY: Guilford Press.

Nielsen, M., & Tomaselli, K. (2010). Overimitation in Kalahari Bushman children and the origins of human cultural cognition. *Psychological Science, 21,* 729–736. doi:10.1177/0956797610368808

Over, H., & Carpenter, M. (2012). Putting the social into social learning: Explaining both selectivity and fidelity in children's copying behavior. *Journal of Comparative Psychology, 126,* 182–192. doi:10.1037/a0024555

Over, H., & Carpenter, M. (2013). The social side of imitation. *Child Development Perspectives, 7,* 6–11. doi:10.1111/cdep.12006

Rakoczy, H. (2008). Taking fiction seriously: Young children understand the normative structure of joint pretense games. *Developmental Psychology, 44,* 1195–1201. doi:10.1037/0012-1649.44.4.1195

Rakoczy, H., Warneken, F., & Tomasello, M. (2008). The sources of normativity: Young children's awareness of the normative structure of games. *Developmental Psychology, 44,* 875–881. doi:10.1037/0012-1649.44.3.875

Schmidt, M. F. H., Rakoczy, H., & Tomasello, M. (2011). Young children attribute normativity to novel actions without pedagogy or normative language. *Developmental Science, 14,* 530–539. doi:10.1111/j.1467-7687.2010.01000.x

Schulz, L. E., Hooppell, C., & Jenkins, A. C. (2008). Judicious imitation: Children differentially imitate deterministically and probabilistically effective actions. *Child Development, 79,* 395–410. doi:10.1111/j.1467-8624.2007.01132.x

Simpson, A., & Riggs, K. J. (2011). Three- and 4-year-olds encode modeled actions in two ways leading to immediate imitation and delayed emulation. *Developmental Psychology, 47,* 834–840. doi:10.1037/a0023270

Sobel, D. M., & Kirkham, N. Z. (2006). Blickets and babies: The development of causal reasoning in toddlers and infants. *Developmental Psychology, 42,* 1103–1115. doi:10.1037/0012-1649.42.6.1103

Southgate, V., Chevallier, C., & Csibra, G. (2009). Sensitivity to communicative relevance tells young children what to imitate. *Developmental Science, 12,* 1013–1019. doi:10.1111/j.1467-7687.2009.00861.x

Spencer, J. P., Smith, L. B., & Thelen, E. (2001). Tests of a dynamic systems account of the A-not-B error: The influence of prior experience on the spatial memory abilities of two-year-olds. *Child Development, 72,* 1327–1346. doi:10.1111/1467-8624.00351

Tomasello, M., Carpenter, M., Call, J., Behne, T., & Moll, H. (2005). Understanding and sharing intentions: The origins of cultural cognition. *Behavioral and Brain Sciences, 28,* 675–691. doi:10.1017/S0140525X05000129

Uzgiris, I. C. (1981). Two functions of imitation during infancy. *International Journal of Behavioral Development, 4,* 1–12. doi:10.1177/016502548100400101

van Baaren, R. B., Holland, R. W., Kawakami, K., & van Knippenberg, A. (2004). Mimicry and prosocial behavior. *Psychological Science, 15,* 71–74. doi:10.1111/j.0963-7214.2004.01501012.x

Want, S. C., & Harris, P. L. (2001). Learning from other people's mistakes: Causal understanding in learning to use a tool. *Child Development, 72,* 431–443. doi:10.1111/1467-8624.00288

Whiten, A., Custance, D. M., Gomez, J.-C., Teixidor, P., & Bard, K. A. (1996). Imitative learning of artificial fruit processing in children (*Homo sapiens*) and chimpanzees (*Pan troglodytes*). *Journal of Comparative Psychology, 110,* 3–14. doi:10.1037/0735-7036.110.1.3

Whiten, A., McGuigan, N., Marshall-Pescini, S., & Hopper, L. M. (2009). Emulation, imitation, over-imitation, and the scope of culture for child and chimpanzee. *Philosophical Transactions of the Royal Society B: Biological Sciences, 364,* 2417–2428. doi:10.1098/rstb.2009.0069

Williamson, R. A., & Markman, E. M. (2006). Precision of imitation as a function of preschoolers' understanding of the goal of the demonstration. *Developmental Psychology, 42,* 723–731. doi:10.1037/0012-1649.42.4.723

Williamson, R. A., Meltzoff, A. N., & Markman, E. M. (2008). Prior experiences and perceived efficacy influence 3-year-olds' imitation. *Developmental Psychology, 44,* 275–285. doi:10.1037/0012-1649.44.1.275

Wohlgelernter, S., Diesendruck, G., & Markson, L. (2010). What is a conventional object function? The effects of intentionality and consistency of use. *Journal of Cognition and Development, 11,* 269–292. doi:10.1080/15248371003699985

Wood, L. A., Kendal, R. L., & Flynn, E. G. (2012). Context-dependent model-based biases in cultural transmission: Children's imitation is affected by model age over model knowledge state. *Evolution and Human Behavior, 33,* 387–394. doi:10.1016/j.evolhumbehav.2011.11.010

Zelazo, P. D., Frye, D., & Rapus, T. (1996). An age-related dissociation between knowing rules and using them. *Cognitive Development, 11,* 37–63. doi:10.1016/S0885-2014(96)90027-1

Zmyj, N., Daum, M. M., & Aschersleben, G. (2009). The development of rational imitation in 9- and 12-month-old infants. *Infancy, 14,* 131–141. doi:10.1080/15250000802569884

Received November 13, 2012
Revision received June 13, 2013
Accepted June 30, 2013 ■