

# Copying Actions and Copying Outcomes: Social Learning Through the Second Year

Mark Nielsen  
University of Queensland

The present work documents how the logic of a model's demonstration and the communicative cues that the model provides interact with age to influence how children engage in social learning. Children at ages 12, 18, and 24 months ( $n = 204$ ) watched a model open a series of boxes. Twelve-month-old subjects only copied the specific actions of the model when they were given a logical reason to do so—otherwise, they focused on reproducing the outcome of the demonstrated actions. Eighteen-month-old subjects focused on copying the outcome when the model was aloof. When the model acted socially, the subjects were as likely to focus on copying actions as outcomes, irrespective of the apparent logic of the model's behavior. Finally, 24-month-old subjects predominantly focused on copying the model's specific actions. However, they were less likely to produce the modeled outcome when the model acted nonsocially.

*Keywords:* social learning, imitation, emulation, tool use, social interaction, development

When young children engage in social learning, they are provided with a way of acquiring new skills and a means of engaging in nonverbal social interaction. Children thus attain many of their most important social and cognitive abilities by observing and copying what others do. It also has been argued that the transmission of culture is founded on instances of social learning involving children, their carers (fathers or babysitters), and objects (Tomasello, 1999; Tomasello, Kruger, & Ratner, 1993). The study of how children learn to use objects by observing others has thus become a topic of central importance to our broader understanding of human development.

A number of studies have established that children who are approximately 6 to 12 months of age can copy what others do with objects (Abravanel & Gingold, 1985; Barr, Dowden, & Hayne, 1996; Barr, Rovee-Collier, & Campanella, 2005; Killen & Uzgiris, 1981; Meltzoff, 1988a, 1988b). From this period onward, the type and number of actions that children can copy increases, and they are able to copy in a widening range of circumstances (Asendorpf, Warkentin, & Baudonnière, 1996; Barnat, Klein, & Meltzoff, 1996; Barr & Hayne, 1999; Carpenter, Akhtar, & Tomasello, 1998; Hanna & Meltzoff, 1993; Hayne, Herbert, & Simcock, 2003;

Herbert & Hayne, 2000; Meltzoff, 1995; Nielsen & Dissanayake, 2004; Rakoczy, Tomasello, & Striano, 2005). Typically, the copying behavior of children in these studies is described as *imitation*. However, using the term *imitation* to broadly refer to all instances of copying may have militated against revealing important changes in the way children engage in social learning.

It has been argued that the term *imitation* should be reserved for instances in which children understand the goal of the model's actions, copy the specific actions used by the model, and reproduce the modeled result (Carpenter, Call, & Tomasello, 2002; Carpenter, Nagell, & Tomasello, 1998; Huang, Heyes, & Charman, 2002; Thompson & Russell, 2004; Want & Harris, 2001; Whiten, Custance, Gomez, Texidor, & Bard, 1996). In this context, *imitation* can be contrasted with *emulation*,<sup>1</sup> whereby children understand the goal of the model's actions and reproduce the modeled result but do not copy the specific actions used by the model. Alternatively, children might *mimic* by copying the actions used by a model to bring about a specific result without understanding why they or the model performed those actions. These terms, and a host of others, are used commonly in studies of social learning in nonhuman animals but, until recently, have rarely been applied to research conducted with human children. Using these terms to describe the behavior of children when they copy, or attempt to copy, what others do with objects may provide a more complete developmental picture of social learning in the second year. Let us first evaluate the evidence for *imitation*.

---

Mark Nielsen Early Cognitive Development Unit, School of Psychology, University of Queensland.

A University of Queensland Early Career Research Grant (122524853) funded the work described in this article. I thank Tamara Christie, Megan Dooley, Michelle Heron, Kristelle Hudry, Linda Jenkins, Anna Lock, Lake-Hui Quek and Rachel Thompson for their help with data collection and coding, and Peter Nielsen for constructing the test apparatus. Portions of this work were presented at the XIV Biennial Meeting of the International Society of Infant Studies, Chicago, IL, 2004, and the Biennial Meeting of the Society for Research in Child Development, Atlanta, GA, 2005.

Correspondence concerning this article should be addressed to Mark Nielsen, Early Cognitive Development Unit, School of Psychology, University of Queensland, Brisbane, QLD 4072, Australia. E-mail: nielsen@psy.uq.edu.au

---

<sup>1</sup> The term *emulation* was originally used by Tomasello (1990) to refer to instances in which an observer learns, by watching others, about the properties of, or causal relations between, objects. Emulation in this sense does not rely on understanding the goal of the model's actions. For this reason, some researchers contrast *emulation* with *goal emulation* (Call & Carpenter, 2002; Want & Harris, 2002; Whiten & Ham, 1992). However, for the purposes of this article, *emulation* is used to refer to instances in which children attempt to produce the same result as a model using their own behavioral strategies.

Meltzoff (1988a) assessed the ability of 14-month-old children to replicate the novel goal-directed actions of an adult. Children watched as a model leaned forward and touched the top of a plastic box with his head. This action illuminated the box by turning on a light that was hidden inside. The children were given the opportunity to play with the box 1 week later, at which point a majority (67%) produced the novel behavior of the model: They leaned forward and touched their head to the box rather than activating the switch through other means, such as by using their hands. The children copied the specific actions of the model, not just the outcome of his actions. In this case, an argument can be made for imitation. However, it is equally plausible that these children did not understand the goals of their (or the experimenter's) actions and that they mimicked rather than imitated the experimenter.

The problem of distinguishing mimicry from imitation in Meltzoff's (1988a) study was addressed by Carpenter, Nagell, and Tomasello (1998). They used Meltzoff's light box task to assess social learning in a longitudinal investigation of 24 infants who were observed at monthly intervals from 9 to 15 months of age. In this study, when the infants activated the box, there was a 1-s delay before the light came on (the box lit up immediately when the action was modeled). The rationale for the delay was that if infants were imitating, and not mimicking, they should look at the box to check that their actions resulted in the same outcome as the model's. From around 12 months of age, infants looked at the light after bending to touch it. It can thus be argued that these infants understood the goal of the experimenter's actions and copied them via imitation.

By 2 years of age, copying by imitation appears to be almost habitual. In situations in which 2-year-old children could devise their own strategies to bring about a behavioral outcome and engage in emulation, they often will persist with the actions shown to them and engage in imitation. For example, Nagell, Olguin, and Tomasello (1993) presented common chimpanzees and 2-year-old human children with a model who demonstrated how a rake-like tool could be used to retrieve a desirable but out-of-reach object. The children used the rake as it was modeled to them, even if a more efficient means was available. In contrast, the chimpanzees devised their own means of using the rake. Nagell et al. argued that the children focused on reproducing the model's actions as well as the result of those actions, whereas the chimpanzees predominantly focused on the result. That is, the children imitated and the chimpanzees emulated.

As illustrated in the aforementioned studies (Carpenter, Nagell et al., 1998; Meltzoff, 1988a), there is evidence that, from early in their second year, children can imitate others. By the beginning of their third year, it appears that children often will fixate on imitating, even to the extent of slavishly copying the actions of a model after discovering that components of the modeled sequence are redundant (Call, Carpenter, & Tomasello, 2005; Carpenter et al., 2002; Horner & Whiten, 2005; Whiten, 2005; Whiten et al., 1996). Does this mean that young children cannot or do not engage in emulation? Recent research suggests otherwise.

There is growing evidence that children in their second year can engage in emulation learning (Gergely, Bekkering, & Kiraly, 2002; Huang et al., 2002; Thompson & Russell, 2004). For example, Gergely et al. (2002) replicated Meltzoff's (1988a) light-box experiment with the addition of a condition in which the model demonstrated the target actions after she had wrapped herself in a

blanket. In this scenario, there was a clear reason for the model to use her head—her hands were occupied. Like those in Meltzoff's study, most of the 14-month-old children (69%) who saw the action demonstrated by a model whose hands were free subsequently copied her behavior: They activated the light by touching the switch with their head. In contrast, only 21% of the children who saw the model when her hands were occupied by the blanket used their head as the model had done. The remaining children turned the light on using their hands. In this case, the children emulated rather than imitated the experimenter. The responses of the children in the study by Gergely et al. raise the question of why children in their third year appear to fixate on copying the specific behavioral strategies used by a model. I return to this point in Experiment 3.

As emphasized in the research reviewed here, there is evidence that 1-year-old children can engage in both imitation and emulation. However, little empirical research has been conducted to evaluate whether or not children use imitation and emulation differently through their second year, a period of marked change in children's copying behavior (e.g., Barr et al., 1996; Barr & Hayne, 2003; Killen & Uzgiris, 1981; Nielsen & Dissanayake, 2004). Important gaps in our understanding of the development of social learning thus remain. The present series of experiments were therefore aimed at identifying whether or not there are age-related changes in the specific social learning strategies adopted by children in their second year and at investigating possible reasons why children might favor one particular strategy over another.

On the basis of a procedure developed by Whiten and his colleagues (Whiten et al., 1996), the copying behavior of 12-, 18-, and 24-month-old children was investigated by providing them with the opportunity to open a series of boxes, each containing a desirable toy. In the experimental condition of Experiment 1, children saw a model open the boxes using an object (object condition). Children could copy the actions of the model and use the object (imitation), or they could ignore the model's object use and open the boxes by hand (emulation). Regardless of the strategy used, children also could succeed or fail in their attempt to open the box. Thus, for the purposes of the present experiments, imitation is distinguished from emulation based on the specific actions of the children, not the outcome of those actions. The outcome is only used to establish the relative success of the strategy used. Experiment 2 was designed to test whether the responses of 12- and 18-month-old children to the model's object use are the result of the apparent rationality of her actions. Finally, Experiment 3 investigated whether or not the tendency of 18- and 24-month-old children to copy the specific actions of a model is influenced by the type of social interaction she provides.

## Experiment 1

### *Method*

#### *Participants*

One hundred eight children were included in this experiment. The final sample comprised 18 girls and 18 boys at 12 months of age ( $M = 12$  months, 7 days; age range = 11 months, 1 day to 13 months, 12 days), 17 girls and 19 boys at 18 months of age ( $M = 17$  months, 24 days; age range = 17 months, 4 days to 19 months, 6 days), and 17 girls and 19 boys at 24 months of age ( $M = 24$  months, 15 days; age range = 23 months, 0

days to 25 months, 8 days). Fifteen children (five 12-month-old children, seven 18-month-old children, and three 24-month-old children) were tested but not included in the final sample because fussiness before completion of testing.

Children's names were taken from the birth announcements of a local newspaper or from an existing subject pool. Parents were contacted via mail and telephone, and anyone who volunteered to participate did so. The children were predominantly White and live in metropolitan suburbs surrounding a university. All children received a small gift for participating.

*Apparatus*

*Boxes.* Children were presented with a series of 3 opaque wooden "boxes" (19.05 cm × 12.05 cm × 6 cm), each containing a desirable toy (see Table 1). Each box was mounted on a wooden base (19.05 cm × 36 cm) and had red sides featuring a zebra decal. Each box had a different-colored lid, and the wooden base of each box featured a different-colored design. The lid to each box was held shut by a hidden mechanism. Operating a switch located on the front of each box disengaged the mechanism, permitting the lid to be opened and the toy to be retrieved. For each box, a different action was required to disengage the mechanism. To motivate interest, each switch was covered by a small plastic face depicting a character from a popular children's story (*Winnie the Pooh*).

*Objects.* Accompanying each box was a set of 3 objects. One set comprised a toy hammer, a toy plastic sieve, and a circular red rattle with 2 arms. A second set comprised a toy spatula, a toy spanner, and a toy rake. The third set comprised a toy scoop, a toy drill, and a plastic block. The rationale for having 3 objects in each set was to provide some index of the degree to which children would attend to the specifics of the model's demonstration. That is, if children copied the model's use of an object (see

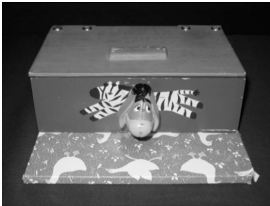

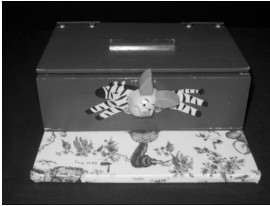
object condition) would they use any object or would they focus on using the same object as the model?

*Procedure*

On arrival, the child and mother were escorted to a room where the child could play to warm up. After this warm-up, they were brought to the testing room. Children either sat in an age-appropriate seat or on their mother's lap. All children were tested while sitting at a table opposite an adult model. A camera was positioned over the shoulders of the model to capture only the behavior of the child for independent coding from video. Children in each of the 3 age groups were divided randomly into 3 experimental groups that were balanced for gender. The presentation order of the boxes was counterbalanced across children. The object set associated with each box, the target object used (see Object Condition), and the side of the box the object set was placed on were all counterbalanced across boxes and children.

*Object condition.* The model took the first box and its associated object set from a container located beneath the table. The children had no prior opportunity to see the box or the objects. The object set was placed to one side of the box. The model picked up the target object from the accompanying set of 3 objects and then demonstrated how the target object could activate the switch to open the box. After the box was opened, the model showed the child the toy hidden inside the box. The model then placed the box under the table and closed it. Hence, the child did not see the box being closed or the mechanism being used. This sequence was repeated twice more so that the child saw the box opened a total of 3 times. Immediately after the third demonstration, the child was presented simultaneously with the closed box and the accompanying object set. The trial was terminated if the child opened the box or after 60 s had expired. This procedure was repeated for the remaining 2 boxes.

Table 1  
*The Three Boxes Used in Experiments 1, 2, and 3 and Their Distinguishing Features*

Box	Lid color	Base features	Switch character	Switch action	Toy
	Green	White geese on a blue background	Eeyore (donkey)	Push inwards	Plastic dial
	Pink	Teddy bears and doll clothes on a brown background	Tigger (tiger)	Slide horizontally from right to left	Finger puppets
	Blue	Yellow and pink flowers on a white background	Piglet (pig)	Rotate anticlockwise	Flashing light

*Control condition 1: Hand condition.* The procedure for the Hand Condition was identical to the procedure for the Object Condition except that the model demonstrated how to activate the switches on each box using her hand (with index and middle fingers extended). Each box was accompanied by an object set, although the objects were never used. This condition was designed to establish whether children could open the boxes by hand and whether or not they would use the objects only when shown by a model.

*Control condition 2: No model condition.* In this condition, no actions were modeled on the boxes and, hence, the children did not see them opened. The experimenter placed the first box and accompanying object set on the table and, after a brief pause, simultaneously presented them both to the child. This sequence was repeated for the remaining 2 boxes. This control assessed whether children would be likely to open the boxes spontaneously and, if so, whether they would do so by hand or by using an object.

*Coding.* All coding was conducted from videotape. To avoid bias, the coder initially was blind to the condition each child had been assigned to. For each trial, the coder was required to judge:

- (a) If the child successfully opened the box.
- (b) If the child attempted to activate the box's switch using an object, regardless of whether or not the manipulation successfully opened the box. Successful activation of the switch was not necessary. As previously outlined, children may understand the goal and copy the actions used by the model yet still fail to bring about the end result. In this case, children could be considered to have engaged in "failed" imitation, but imitation nonetheless (Call & Carpenter, 2002).
- (c) After coding all 3 trials, the coder identified the condition in which the child was. If the child was in the Object condition, the coder further recorded for each trial whether he or she attempted to activate the box's switch using the target object or a nontarget object.

For each trial, the child was awarded a score of 1 when a particular target action was exhibited (e.g., using an object, opening the box) and 0 for failing to demonstrate the action. Hence, for each of the 3 aforementioned criteria, children could score from 0 to 3. A second coder who was blind to the specific hypotheses and conditions of the experiment independently observed and coded the videotape of 27 randomly selected children (9 from each age group). Intraclass correlation coefficients (Shrout & Fleiss, 1979) indicated that there was good agreement between coders on the number of boxes each child opened ( $r = .97$ ), the number of boxes that each child attempted to open by placing an object to the switch ( $r = .95$ ), and the number of boxes that each child successfully opened using an object ( $r = .95$ ).

## Results

Across all analyses, there was no significant main effect for gender and no significant interactions with other variables. Thus, gender is not considered further. Also, to reiterate, the rationale for having 3 objects in each set was to provide an index of the degree to which children would attend to the specifics of the model's demonstration. Children could broadly copy the model's use of an object and use any of the 3 objects provided, or they could more specifically focus on using the same object that the model had used. Of the 53 individual instances in which children in the Object condition touched a switch with an object, on only 9 occasions was this done using a nontarget object (i.e., one not used by the model).

Thus, if children were going to copy the model's object use, they were highly likely to do so using the same object as the model. Therefore the specific object used by the children was not analyzed further.

There were 2 objectives to the following analyses. The first objective was to establish (a) that children at each of the 3 ages studied here could learn from the model's demonstration that the boxes could be opened and (b) that children could open the boxes by hand. The second objective was to evaluate the tendency of these children to copy the actions used by the model. If the children were likely to copy the model's actions, they should use the object in an attempt to activate the switch only when they had seen the model perform this action (i.e., in the Object condition but not in the Hand or No Model conditions).

### Successful Opening of Boxes

Table 2 presents the mean number of boxes children opened as a function of age and condition. For each age group, the mean number of boxes opened was analyzed with an analysis of variance with condition (Object, Hand, and No Model) as a between-participants factor.

For 12-month-old subjects, there was a significant main effect for condition,  $F(2, 33) = 6.31, p = .005, \eta^2 = .28$ . Tukey's HSD post hoc tests indicated that 12-month-old children in the Hand and Object conditions opened more boxes than children in the No Model condition, with  $p = .011$  for both contrasts. There was no difference in the number of boxes opened by 12-month-old subjects in the Hand and Object conditions.

The main effect for condition was significant for the 18-month-old children,  $F(2, 33) = 6.64, p = .004, \eta^2 = .29$ . Post hoc tests indicated that 18-month-old children in the Hand condition opened more boxes than children in either the Object or No Model conditions, with  $p = .027$  and  $p = .004$ , respectively. The difference in the number of boxes opened by 18-month-old children in the Object and No Model conditions was not significantly different.

The main effect for condition was also significant for the 24-month-old children,  $F(2, 33) = 9.08, p = .001, \eta^2 = .36$ . Post hoc tests indicated that 24-month-olds in the Hand condition opened more boxes than children in either the Object or No Model conditions, with  $p = .012$  and  $p = .001$ , respectively. As was the case for 18-month-old subjects, the difference in the number of boxes opened by 24-month-old children in the Object and No Model conditions was not significantly different.

To summarize, children across each of the 3 age groups tested here opened more boxes after observing a model activate the

Table 2  
*The Mean Number (and Standard Deviation) of Boxes Opened According to Age and Condition in Experiments 1, 2, and 3*

Experiment	Condition	12 months	18 months	24 months
Experiment 1	No model	0.25 (0.45)	0.42 (0.51)	0.83 (0.83)
Experiment 1	Hand	1.17 (0.94)	1.58 (1.08)	2.17 (0.72)
Experiment 1	Object	1.17 (0.72)	0.67 (0.78)	1.17 (0.83)
Experiment 2	Failed hand	0.66 (0.89)	1.00 (0.95)	
Experiment 2	Object only	0.83 (1.11)	1.17 (0.94)	
Experiment 3	Social		1.00 (0.95)	1.58 (1.00)
Experiment 3	Aloof		0.75 (0.75)	0.58 (0.51)

switches using her hand than when they were not shown that the boxes could be opened. These results demonstrate that children in their second year are able to open the boxes using their hands and that they are unlikely to do so spontaneously. With regard to children who saw the model activate the switches using an object, 12-month-old children opened the same number of boxes as those in the Hand condition, and a greater number of boxes than those in the No Model condition. In contrast, 18- and 24-month-old children in the Object condition opened fewer boxes than same-aged children in the Hand condition and an equivalent number of boxes as those in the No Model condition. To explain this rather counterintuitive finding, we need to look at the specific actions these children used in attempting to get the boxes open.

### *Means of Opening the Boxes*

Only one 12-month-old, one 18-month-old, and six 24-month-old children opened a box by activating its switch using an object. Each of these 8 children were in the Object condition, which may be taken to suggest that the remaining 28 children in the Object condition did not imitate. However, it was not easy to disengage the switches using an object, and these children may have engaged in “failed” imitation, whereby they understood the goal of the model’s actions and copied those actions yet still failed to bring about the end result. Therefore, the next step in analysis was to evaluate the tendency of children to attempt to use an object to activate a switch.

Table 3 presents the mean number of boxes in which children touched a switch using an object, as a function of age and condition. Here, it is evident that children in the Object condition showed a tendency, increasing with age, to use an object to touch the switches. In contrast, children in the Hand and No Model conditions were highly unlikely to use an object in this way.

The mean number of boxes in which children touched a switch using an object was analyzed using separate analyses of variance for each age group with condition (Object, Hand, and No Model) as a between-participants factor. For 12-month-old subjects, the main effect for condition was not significant, indicating that there was little difference across conditions in the number of switches touched using an object. In contrast, for the 18- and 24-month-old groups, there was a significant main effect for condition,  $F(2, 33) = 11.21, p = .000, \eta^2 = .41$  and  $F(2, 33) = 187.53, p = .000, \eta^2 = .92$ , respectively. For both age groups post-hoc comparisons indicated that the mean score for the Object condition was higher than the mean score for both Hand ( $p = .001$  for 18-month-old

children and  $p = .000$  for 24-month-old children) and No Model ( $p = .001$  and  $p = .000$ ) conditions. The mean scores for the Hand and No Model conditions were not different from each other. Thus, regardless of condition, few 12-month-old children touched a switch using an object. In contrast, 18- and 24-month-old subjects in the Object condition touched more switches using an object than same-aged children in either the Hand or No Model conditions.

### *Discussion*

All children were able to learn from the model’s demonstration that the boxes could be opened, and they rarely used an object in an attempt to activate the switch on any box unless the model had previously done so. Nonetheless, their tendency to copy the model’s use of an object varied with age. Most of the 24-month-old children copied the model’s object use on all 3 boxes and persisted in using this method, even though it was ultimately unsuccessful. In line with previous research, 2-year-old subjects appear to fixate on copying the behavioral means used by others to bring about a specific outcome. They may be considered habitual imitators (albeit “failed imitators” in this experiment). Eighteen-month-old children also copied the model’s object use, but they rarely did so on all 3 trials. On those trials in which they did not use an object, they used their hands. Thus, at 18 months of age, the same children in the same situation who were presented with a similar problem both emulated and imitated.

The way 12-month-old children copied the model was in stark contrast to 18- and 24-month-old subjects. It was rare for 12-month-old children in the Object condition to attempt to touch a switch using an object; rather, they used their hands. Thus, although these children attempted to reproduce the result of the model’s actions (i.e., opening the boxes) they did not copy the behavioral means used by the model (i.e., using an object). It could therefore be argued that the 12-month-old subjects engaged in emulation but not imitation. There is, however, a viable alternative to this interpretation.

It has been suggested that young infants are not ready to copy the actions of others that involve the use of one object as a tool to act on a second object (Meltzoff, 1995; Visalberghi & Limongelli, 1996). Twelve-month-old subjects may have failed to use the objects simply because they were unable to. Alternatively, in so far as getting the boxes open is concerned, using one’s hand is a more efficient means of activating the switches than using an object. Perhaps 12-month-old children based their responses on using the most appropriate means of achieving the modeled result. Further, as noted previously, 18-month-old subjects were less likely than the 24-month-old subjects to use an object across all 3 boxes. Hence, 18-month-old subjects also may have been drawn to respond using the most direct means of opening the boxes. This raises the question: Will 12- and 18-month-old subjects be more likely to use an object if given a logical reason to do so? To test this, in Experiment 2, children were again shown a model successfully opening the boxes using an object. However, before using the object, the model attempted but “failed” to open the boxes using her hands. The children were thus given a reason to use the object—the alternative hand operation did not “work.”

Table 3  
*The Mean Number (and Standard Deviation) of Boxes in Which Children Touched a Switch Using an Object, According to Age and Condition in Experiments 1, 2, and 3*

Experiment	Condition	12 months	18 months	24 months
Experiment 1	No model	0.17 (0.39)	0.17 (0.58)	0.00 (0.00)
Experiment 1	Hand	0.08 (0.29)	0.08 (0.29)	0.08 (0.29)
Experiment 1	Object	0.33 (0.65)	1.33 (1.07)	2.75 (0.62)
Experiment 2	Failed hand	1.50 (0.80)	1.33 (1.37)	
Experiment 2	Object only	0.67 (0.78)	1.50 (1.09)	
Experiment 3	Social		1.42 (1.08)	1.58 (1.31)
Experiment 3	Aloof		0.42 (0.51)	1.67 (1.27)

## Experiment 2

### Method

#### Participants and Procedure

Children were recruited in a manner identical to Experiment 1. Forty-eight children were included in this experiment. The final sample comprised 13 girls and 11 boys at 12 months of age ( $M = 12$  months, 27 days; age range = 11 months, 26 days to 13 months, 10 days) and 11 girls and 13 boys at 18 months of age ( $M = 17$  months, 22 days; age range = 17 months, 1 day to 18 months, 23 days). One 12-month-old and two 18-month-old subjects were tested but not included in the final sample because fussiness before the completion of testing.

The boxes used in Experiment 1 were used again in Experiment 2. Because the nontarget objects were rarely used in the Object condition of Experiment 1, each box was accompanied by only one object (different for each box). The objects were selected randomly from the 9 objects used in Experiment 1. Otherwise, the general procedure was identical to Experiment 1. No control groups were included here, because it was demonstrated in Experiment 1 that it is rare, in the absence of modeling, for children to spontaneously open the boxes or to spontaneously attempt to activate a switch using an object.

*Object-only condition.* This condition was identical in all respects to the Object condition of Experiment 1, except that each box was paired with one object only. That is, there were no distracter objects.

*Failed hand condition.* The experimenter took the first box and an object from a container located beneath the table (i.e., the children had no prior opportunity to see the box or the objects). The object was placed to one side of the box. The experimenter then placed her fingers to the switch as per the Hand Condition of Experiment 1 (with middle and index fingers extended). In this case, however, the experimenter acted as if she was expending effort in attempting to move the switches but was nonetheless "unable" to activate them. Hence, she "failed" to activate the switch, and the box was not opened. The experimenter made two further "failed" attempts at activating the switch with her hand. After the third "failed attempt," the experimenter picked up the object and successfully used it to open the box by activating the switch in the same manner as in the Object condition of Experiment 1. After the box was opened, the model showed the child the toy hidden inside the box. The model then placed the box under the table and closed it so that the child did not see the box being closed or the mechanism being used. The child was then simultaneously presented with the closed box and the object. The trial was terminated if the child opened the box (whether by object or by hand) or when 60 s had expired. This procedure was repeated for the remaining 2 boxes. All coding was conducted from videotape. As per the criteria outlined in Experiment 1, for each trial the coder was required to judge (a) if the child attempted to activate the box's switch using an object and (b) if the child successfully opened the box.

### Results and Discussion

The mean numbers of boxes children opened are shown in Table 2. Independent samples  $t$  tests indicated that there was no difference in the number of boxes opened by children in the Failed Hand and Object Only conditions at 12 months of age or at 18 months of age. The critical question is whether or not providing children with a logical reason to use an object increased the likelihood that they would do so. Table 3 presents the mean number of boxes in which children touched a switch using an object. Independent samples  $t$  tests revealed that 12-month-old children in the Failed Hand condition touched significantly more switches using an object than 12-month-old children in the Object-Only condition,  $t(22) = 2.59$ ,

$p = .017$ . In contrast, 18-month-old subjects in the Failed Hand and Object-Only conditions used an object at equivalent levels.

Young children may not be ready to copy the actions of others that involve the use of one object as a tool to act on a second object (Meltzoff, 1995; Visalberghi & Limongelli, 1996). Meltzoff has suggested that, when observing others using a tool, young children may be more likely to focus "on the body transformations per se (both the arm and finger movements) than on the whole means-ends plan involving the tool" (1995, p. 847). This suggestion may be accurate for younger infants, but Experiment 2 demonstrates that, at least from 12 months of age, children can learn to use tools from watching others. Given an appropriate reason, 12-month-old subjects used an object in an attempt to open the boxes. It is thus unlikely that the lack of object use in Experiment 1 is because children of this age are not able to use one object to act on another or because the introduction of the object made the task too difficult for them in some other way.

Children who saw a "Failed Hand" demonstration were provided with a rationale for using the object—the model showed that she could not open the boxes using her hands. Only in this new condition did 12-month-old subjects attempt to activate the switches using an object. In contrast, 18-month-old subjects who saw a "Failed Hand" demonstration did not attempt to use an object to open the boxes with greater frequency than same-aged children in the Object-Only condition. Providing a justifiable reason to use the objects increased the likelihood that 12-month-old subjects, but not 18-month-old subjects, would subsequently copy this action. These findings are consistent with reports that whereas 14-month-old children will copy the actions of others only if those actions seem to them to be the most efficient alternative available, 18-month-old children will copy the novel actions of a model regardless of the apparent logic of the demonstration (Gergely, 2003b; Gergely et al., 2002; Gergely & Király, 2004, May; see also Carpenter et al., 2002 and Want & Harris, 2001).

Twelve-month-old children focus more on producing the outcome of a model's action than on the actions themselves. Such responding appears to be mediated to some degree by the logic underpinning the actions. If there is no clear reason to use certain actions, they will likely be ignored (cf. Carpenter, Call, & Tomasello, 2005). By 18 months of age, copying behavior seems to be less determined by the logic underpinning a model's actions. Children of this age did not copy the specific actions of the model with greater frequency when given a logical reason to do so than when not given a logical reason. What other factors might influence toddlers to copy the specific actions used by a model?

According to Uzgiris (1981), young toddlers copy others primarily to satisfy cognitive motivations, to promote learning about events in the world. Young toddlers will thus predominantly attend to what a model has done (i.e., the outcome). In contrast, older toddlers are more motivated to copy to satisfy social motivations, to fulfill an interpersonal function of promoting shared experience with others. Older toddlers will thus predominantly attend to how a model did something (i.e., the actions). By this reasoning, the 18- and 24-month-old children studied here may have copied the model's specific actions to satisfy social motivations. If so, then children at these ages will be more inclined to copy the specific actions of a model when she is engaging and social than when she acts disinterested and aloof. This hypothesis was tested in Experiment 3.

## Experiment 3

### Method

#### Participants

Children were recruited in a manner identical to Experiment 1. Forty-eight children were included in this experiment. The final sample comprised 11 girls and 13 boys at 18 months of age ( $M = 18$  months, 0 days; age range = 17 months, 5 days to 19 months, 20 days) and 13 girls and 11 boys at 24 months of age ( $M = 24$  months, 6 days; age range = 23 months, 3 days to 25 months, 1 day). Four 18-month-old children (3 in the social condition) and three 24-month-old children (1 in the social condition) were tested but not included in the final sample because of fussiness before completion of testing. One 18-month-old (social condition) and two 24-month-old subjects (both in the aloof condition) also were excluded because of experimenter error.

#### Apparatus

The boxes used in Experiments 1 and 2 were again used here. As with Experiment 2 each box was accompanied by one object (different for each box), randomly selected from the 9 objects used in Experiment 1.

#### Procedure

On arrival, an assistant escorted the toddler and carer to a room in which the toddler could play to warm up. After this warm-up period (typically 5 min), they were brought to the testing room. Upon entering the room, the assistant invited the toddler to sit on a cushion next to her. The child's carer was asked to sit behind them on a sofa. The assistant and child then played with some toys that were incidental to the test apparatus. The model sat at a table approximately 2 m from the child. Initially, the boxes were hidden behind an opaque screen. A camera was positioned next to the screen to capture the behavior of the child for independent coding from video.

Once the child appeared comfortable, the model retrieved the first box and its accompanying object from behind the screen and the assistant drew the child's attention to the model by pointing and saying: "Look at [model's name], what is she doing?" The model then demonstrated how to open the box using the object in the same way as in Experiment 1 and Experiment 2. After the box was opened, the model took the toy from the box so that the child could see what had been hidden inside. The model then placed the toy back in the box and closed it behind the screen. This sequence was repeated twice so that the child saw the box opened a total of 3 times. Throughout modeling, the assistant continued to draw the attention of the child to the model and repeated comments such as "Look at that!" and "Isn't that great!" After the third demonstration, the model placed the toy back in the box, closed it behind the screen, and then placed the box and the object on the table in front of her. The assistant then retrieved the box and brought it to the child, who remained sitting in the cushion. The trial was terminated if the child opened the box or when 30 seconds had expired.<sup>2</sup> This procedure was repeated for the remaining 2 boxes. Children saw the boxes opened in 1 of the 2 following conditions.

*Social condition.* To increase the opportunity to build rapport, the model met the child before testing and played with him or her during the warm-up phase. When the assistant escorted the child and carer to the test room, the model accompanied them. While the assistant was playing with the child, familiarizing him or her with the test room, the model sat at the table and engaged in appropriate social interaction (e.g., smiling, eye contact). During demonstration, the model focused on the object and box but after taking the toy from the box she alternated gaze between the toy and the child. When the child was given the box by the assistant, the model maintained eye contact with the child and smiled at him or her.

*Aloof condition.* To minimize social contact, the model did not meet the child before testing. When the child was brought into the test room, the

model was seated at the table reading a book and did not look up. While the assistant was familiarizing the child with the test room, the model continued to read and avoided engaging with the child. Like the social condition, during demonstration the model focused on the object and the box. Unlike the social condition when the toy was retrieved from the box, the model maintained focus on the toy and avoided eye contact with the child. Recall that in both conditions the assistant constantly drew the child's attention to the model. When the assistant gave the child the box, the model returned to reading her book.

All coding was conducted from videotape. After the criteria outlined previously, for each trial the coder was required to judge (a) if the child attempted to activate the box's switch using an object and (b) if the child successfully opened the box.

### Results and Discussion

The mean number of boxes children opened as a function of age and condition are shown in Table 2. Independent samples *t* tests indicated that 18-month-old subjects in the Social condition opened a similar number of boxes to those in the Aloof condition. In contrast, 24-month-old subjects in the Social condition opened significantly more boxes than same-aged children in the Aloof condition,  $t(22) = 3.09, p = .005$ .

Table 3 presents the mean number of boxes in which 18- and 24-month-olds touched a switch using an object in the Social and Aloof conditions. Eighteen-month-old children in the Social condition attempted to open significantly more boxes using an object than 18-month-old children in the Aloof condition,  $t(22) = 2.89, p = .009$ . Twenty-four-month-old children attempted to open the same number of boxes using an object regardless of whether they were in the Social condition or the Aloof condition.

Uzgiris (1981) argued that older toddlers are more motivated to copy to satisfy social motivations than they are to promote learning about events in the world. As a function of this social motivation to copy, older toddlers will be more likely than younger toddlers to focus on how a model did something. In line with this argument, it was hypothesized that 18- and 24-month-old children would be more inclined to copy the specific actions of a model when she was engaging and social than when she acted disinterested and aloof. This hypothesis was supported for 18-month-old subjects. Regardless of condition, 18-month-old subjects opened the same number of boxes. However, these children were more likely to copy the model's method of getting the boxes open when the model acted socially toward them than when she did not. Contrary to expectation, and in contrast to the responses of 18-month-old subjects, the social disposition of the model had no bearing on the tendency of 24-month-old children to copy the model's specific actions; they used an object at equivalent rates across conditions. However, these toddlers opened more boxes when the model acted socially.

How might we account for the finding that the social disposition of the model influenced the number of boxes opened by 24-month-old but not by 18-month-old subjects? First, it is noteworthy that children rarely opened the boxes on their initial attempt (as was the case in Experiments 1 and 2). Rather, they had to persistently try to activate the switches. In this context, children's attempts at

<sup>2</sup> Thirty seconds was used here as pilot testing indicated that children were unlikely to sit still and focus on the task for 60 s, the time used in Experiments 1 and 2, during which children sat at a table on their carer's lap.

copying were coupled with attention from the model in the social condition but not in the aloof condition. For the 18-month-old subjects it appears that, in the absence of social reinforcement, the motivation to copy to acquire new skills or to achieve the desired end result was sufficient to encourage persistent attempts at opening the boxes. The 24-month-old subjects, however, needed social reinforcement as motivation to persist in producing the modeled outcome.

Regardless of their motivation to produce a modeled outcome, it seems that if the model acts in a detached manner, 18-month-old children will be less likely to copy her specific actions than if she is social and engaging. After Uzgiris (1981), it may be suggested that 18-month-old children copied the specific actions of the social model to sustain interaction and convey mutuality with her. The 24-month-old subjects appeared not to be affected by the model's social disposition in this way. Perhaps 24-month-old children are not motivated to copy to fulfill a social function. There is an alternative explanation. Copying others can be used as a means of *initiating* interaction, as well as a way of sustaining interaction (Uzgiris, 1981, 1991). In this context, 24-month-old children in the social condition may have copied the model's object use to maintain social interaction while those in the aloof condition did so in an attempt to initiate interaction.

If this interpretation is accurate, children of both ages copied the model's object use in the social condition to sustain interaction. However, 24-month-olds also copied the model's object use in the aloof condition to initiate interaction. Consistent with this interpretation, children have been shown to use imitation as a means of sustaining interaction from 18 months onward (Asendorpf & Baudonnière, 1993; Asendorpf et al., 1996; Eckerman, Davis, & Didow, 1989; Eckerman & Didow, 1989, 1996; Nadel, 1986; Nadel-Brulfert & Baudonnière, 1982; Nielsen & Dissanayake, 2004). It also has been demonstrated that children will regularly use imitation to initiate interaction from the beginning of the third year (Grusec & Abramovitch, 1982; Lubin & Field, 1981; Mueller & Lucas, 1975; Nadel-Brulfert & Baudonnière, 1982). The only study to report attempts at initiating interaction via imitation in 18-month-old subjects indicates that such behavior is not common in children of this age (Asendorpf & Baudonnière, 1993).

A note of caution in interpreting the results of the present experiment is warranted. Children in the aloof condition were presented with a model who acted abnormally. That is, it is most uncommon for children to be confronted by an adult who neither looks nor smiles at them. The responses of the children may therefore be the result of age-related changes in the way 2-year-old children respond to feelings of wariness when confronted with an adult's strange behavior. Further research is required to tease apart alternative explanations, such as this, for the data presented here.

There is a long history of conceptualizing children's copying behavior in 2 primary ways: one that emphasizes the cognitive function of copying in promoting learning about events in the world and one that emphasizes the interpersonal function of copying in promoting children's sharing of experience with others (Baldwin, 1894; Meltzoff, 1990; Meltzoff & Decety, 2003; Meltzoff & Gopnik, 1993; Mitchell, 1987; Nadel, Guérini, Pez , & Rivet, 1999; Tomasello, 1999; Tomasello & Rakoczy, 2003; Uzgiris, 1981, 1984; Wallon, 1934). Yet, in contrast to the corpus of research charting the learning function of imitation, there has been little empirical developmental investigation of the social function

of imitation. The present experiment shows that the interaction style of a model can influence the way 18- and 24-month-old toddlers copy. More detailed study of the effect social cues have on children's copying behavior is warranted.

## General Discussion

The present experiments investigated social learning in young children by presenting 12-, 18-, and 24-month-old children with a model who demonstrated how a series of boxes could be opened to obtain a desirable toy. In Experiment 1, 12-month-old subjects who saw the model use an object to open the boxes did not copy this behavioral strategy: They used an alternative means of getting the boxes open. In contrast, 18- and 24-month-old subjects copied the model's object use, with the 24-month-old subjects doing so with greater frequency. In Experiment 2, 12-month-old subjects showed that they would copy the actions of the model if given a logical reason to do so. The rationale for the model's actions had little influence on the copying behavior of 18-month-old subjects: Children of this age were no more likely to adopt the model's actions when given a logical reason to do so than when not given such reason. Finally, in Experiment 3 the influence of a model's communicative cues on the 18- and 24-month-old subjects' copying behavior was investigated. Eighteen-month-old subjects were more likely to copy the actions of the model when she acted in an engaging manner than when she acted aloof. The 24-month-old subjects copied the actions of the model regardless of her social disposition yet were more likely to produce the end result of these actions when the model was being social. These results show that the logic of a model's demonstration and the communicative cues she provides interact with age to influence how children engage in social learning.

Twelve-month-old subjects adopted the behavioral strategy of the model when she presented them with a rational reason to do so. Otherwise, they used their own means to bring about the modeled result. The experiments presented here thus demonstrate that 12-month-old children can engage in both emulation and imitation. This finding is an important one: It has been previously argued that children of this age do not engage in either form of social learning but are rather limited to mimicking others (Want & Harris, 2002). Experiment 2 also provides evidence that 12-month-old children can learn to use one object to act on another. Children do have the capacity for tool use from the beginning of their first year.

The results of the present experiments also indicate that, at least from 18 months of age onward, the same children in the same situation presented with a similar problem can both emulate and imitate. Most of 18-month-old children who saw a model use an object to open a box imitated this action but not on all 3 trials. On those trials in which they did not use an object, they engaged in emulation and used their hands. Nonetheless, unlike 12-month-old children, providing 18-month-old subjects with a justifiable reason to adopt the model's behavioral strategy did not increase the likelihood that they would do so. What did influence the specific strategy adopted by 18-month-old subjects was the social disposition of the model: An aloof model was more likely to elicit emulation than imitation.

By 2 years of age, children are more likely to imitate than emulate. Indeed it was not only common for 24-month-old subjects to use the object as the model had done but to persist in using this



method, even though it was ultimately unsuccessful. To get the boxes open, these children should have ignored the model's actions and used their hands instead. Such behavior is nevertheless consistent with research showing that 2- to 4-year-old children will insist on copying the behavioral means by which a model produced a particular goal, even if a more efficient method is available (Horner & Whiten, 2005; Nagell et al., 1993; Whiten et al., 1996). Indeed, Whiten et al. (1996) suggested that for 2- to 4-year-old children, the cultural and conventional tendency to copy in detail what others do "may be so adaptive as a general strategy for humans that it remains habitual even in a specific situation in which less fidelity would actually afford more efficiency" (p. 11).

Following Uzgiris (1981), it has been argued here that 12-month-old children copy primarily to satisfy cognitive motivations, to promote learning about events in the world. Hence, they predominantly focus on producing the outcome of another's actions rather than the actions themselves. By 24 months, children are more motivated to copy to satisfy social motivations, to fulfill an interpersonal function of promoting shared experience with others. They will copy the specific actions used by a model to both initiate and sustain interaction. When the opportunity for social interaction is reduced, so too is the motivation of these children to produce the modeled result. Eighteen-month-old children show a pattern of response that is intermediate between the younger and older children tested here. At 18 months, children remain motivated to acquire new skills through copying and will attempt to produce the outcome of a model's actions regardless of the interaction style of the model. However, if the model does not interact socially with the child she or he will focus more on producing the modeled outcome, and less on copying the specific actions used to do so.

The argument outlined here may be taken to indicate that the social function of copying only develops after the instrumental function. Yet, there is evidence that neonates will copy a range of facial gestures, including emotional expressions (Field, Woodson, Greenberg, & Cohen, 1982; Legerstee, 1991; Meltzoff & Moore, 1977). As the actions that neonates copy are already within the newborn behavioral repertoire, it is not clear what sort of skill-learning would be implicated in these acts. Rather, neonatal imitation typically is conceived as a fundamentally social act. For example, Meltzoff and Moore (1992, 1995) argue that copying others is a powerful early means of social interaction and that it is crucial for forging social relationships. It is therefore likely that the social function of copying is established well before the child's first birthday. What may happen is that around 12 months of age children are making such rapid gains in motor skill development and in their ability to manipulate and understand the affordances of objects that the skill acquisition function of copying takes temporary precedence (S. Rogers, personal communications, November 11, 2004). Copying to promote shared experience becomes reestablished as children develop other key social—cognitive skills in the second year, such as the capacity for reading intentionality into the behavior of others (Carpenter, Akhtar et al., 1998; Meltzoff, 1995; Moore & Corkum, 1998; Repacholi & Gopnik, 1997; Tomasello, Carpenter, Call, Behne, & Moll, 2005). Systematic investigation of the effect interpersonal interaction has on copying behavior through the first year is needed to provide a clearer developmental picture of social learning in the transition from infancy to childhood.

There are, of course, viable alternatives to the interpretation that toddlers persist in copying the specific actions of others because they are motivated to be social and to promote interaction with the model. For example, by the end of the second year, toddlers may come to presume that adults, as logical mental agents, will have already tested the rationality of the novel action themselves—especially if the model demonstrates how to do something repeatedly—and they thus interpret the adult's actions as an attempt at teaching, at transmitting relevant knowledge to him or her (Csibra & Gergely, 2006; Gergely, 2003a; Gergely et al., 2002; Gergely & Csibra, 2005; Horner & Whiten, 2005). Another explanation is that, to better understand the goals of others, older toddlers are predisposed to attend more to a model's actions than to the results of these actions (Bellagamba & Tomasello, 1999; Call & Carpenter, 2002). Further research is needed to test the veracity of these different accounts of the development of social learning.

The experiments presented here provide important insights into the development of social learning in young children that are unlikely to have been obtained had the copying behavior of the children been classified only as imitation. These experiments demonstrate that children in their second year should not be exclusively classified as imitators or emulators (or according to any other type of social learning). Rather, children's copying behavior is highly flexible and the type of social learning they engage in will be determined by a host of personal, interpersonal and situational variables.

## References

- Abravanel, E., & Gingold, H. (1985). Learning via observation during the second year of life. *Developmental Psychology, 21*, 614–623.
- Asendorpf, J. B., & Baudonnière, P.-M. (1993). Self-awareness and other-awareness: Mirror self-recognition and synchronic imitation among unfamiliar peers. *Developmental Psychology, 29*, 88–95.
- 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.
- Baldwin, J. M. (1894). *Mental development in the child and the race*. New York: MacMillan.
- Barnat, S. B., Klein, P. J., & Meltzoff, A. N. (1996). Deferred imitation across changes in context and object: Memory and generalisation in 14-month-old infants. *Infant Behaviour and Development, 19*, 241–251.
- Barr, R., Dowden, A., & Hayne, H. (1996). Developmental changes in deferred imitation by 6- to 24-month-old infants. *Infant Behaviour and Development, 19*, 159–171.
- Barr, R., & Hayne, H. (1999). Developmental changes in imitation from television during infancy. *Child Development, 70*, 1067–1081.
- Barr, R., & Hayne, H. (2003). It's not what you know, it's who you know: Older siblings facilitate imitation during infancy. *International Journal of Early Years Education, 11*, 7–21.
- Barr, R., Rovee-Collier, C., & Campanella, J. (2005). Retrieval protracts deferred imitation by 6-month-olds. *Infancy, 7*, 263–283.
- Bellagamba, F., & Tomasello, M. (1999). Re-enacting intended acts: Comparing 12- and 18-month-olds. *Infant Behaviour and Development, 22*, 277–282.
- Call, J., & Carpenter, M. (2002). Three sources of information in social learning. In K. Dautenhahn & C. L. Nehaniv (Eds.), *Imitation in animals and artifacts* (pp. 211–228). Cambridge, MA: MIT Press.
- Call, J., Carpenter, M., & Tomasello, M. (2005). Copying results and copying actions in the process of social learning: Chimpanzees (*Pan*

- troglodytes*) and human children (*Homo sapiens*). *Animal Cognition*, 8, 151–163.
- Carpenter, M., Akhtar, N., & Tomasello, M. (1998). Fourteen- through eighteen-month-old infants differentially imitate intentional and accidental actions. *Infant Behaviour and Development*, 21, 315–330.
- Carpenter, M., Call, J., & Tomasello, M. (2002). Understanding “prior intentions” enables 2-year-olds to imitatively learn a complex task. *Child Development*, 73, 1431–1441.
- Carpenter, M., Call, J., & Tomasello, M. (2005). Twelve- and 18-month-olds copy actions in terms of goals. *Developmental Science*, 8, F13–F20.
- Carpenter, M., Nagell, K., & Tomasello, M. (1998). Social cognition, joint attention, and communicative competence from 9 to 15 months of age. *Monographs of the Society for Research in Child Development*, 63(4, Serial No. 255).
- Csibra, G., & Gergely, G. (2006). Social learning and social cognition: The case of pedagogy. In M. H. Johnson & Y. M. Munakata (Eds.), *Processes of change in brain and cognitive development. Attention and Performance*, XXI (pp. 249–274). Oxford: Oxford University Press.
- Eckerman, C. O., Davis, C. C., & Didow, S. M. (1989). Toddlers’ emerging ways of achieving social coordinations with a peer. *Child Development*, 60, 440–453.
- Eckerman, C. O., & Didow, S. M. (1989). Toddlers’ social coordinations: Changing responses to another’s invitation to play. *Developmental Psychology*, 25, 794–804.
- Eckerman, C. O., & Didow, S. M. (1996). Nonverbal imitation and toddlers’ mastery of verbal means of achieving coordinated action. *Developmental Psychology*, 32, 141–152.
- Field, T. M., Woodson, R., Greenberg, R., & Cohen, D. (1982). Discrimination and imitation of facial expressions in neonates. *Science*, 218, 179–181.
- Gergely, G. (2003a). The development of teleological versus mentalizing observational learning strategies in infancy. *Bulletin of the Menninger Clinic*, 67, 113–131.
- Gergely, G. (2003b). What should a robot learn from an infant? Mechanisms of action interpretation and observational learning in infancy. *Connection Science*, 15, 191–209.
- Gergely, G., Bekkering, H., & Kiraly, I. (2002). Rational imitation in preverbal infants. *Nature*, 415, 755.
- Gergely, G., & Csibra, G. (2005). The social construction of the cultural mind: Imitative learning as a mechanism of human pedagogy. *Interaction Studies*, 6, 463–481.
- Gergely, G., & Király, I. (2004, May). *The role of communicative-referential cues and teleological reasoning in observational learning of novel means during the second year*. Paper presented at the XIV Biennial Meeting of the International Society of Infant Studies, Chicago, IL.
- Grusec, J. E., & Abramovitch, R. (1982). Imitation of peers and adults in a natural setting: A functional analysis. *Child Development*, 53, 636–642.
- Hanna, E., & Meltzoff, A. N. (1993). Peer imitation in laboratory, home, and day-care contexts: Implications for social learning and memory. *Developmental Psychology*, 29, 1–12.
- Hayne, H., Herbert, J., & Simcock, G. (2003). Imitation from television by 24- and 30-month-olds. *Developmental Science*, 6, 254–261.
- Herbert, J., & Hayne, H. (2000). Memory retrieval by 18–30-month-olds: Age-related changes in representational flexibility. *Developmental Psychology*, 36, 473–484.
- Horner, V., & Whiten, A. (2005). Causal knowledge and imitation/emulation switching in chimpanzees (*Pan troglodytes*) and children (*Homo sapiens*). *Animal Cognition*, 8, 164–181.
- Huang, C., Heyes, C., & Charman, T. (2002). Infants’ behavioral reenactment of “failed attempts”: Exploring the roles of emulation learning, stimulus enhancement, and understanding of intentions. *Developmental Psychology*, 38, 840–855.
- Killen, M., & Uzgiris, I. (1981). Imitation of actions with objects: The role of social meaning. *Journal of Genetic Psychology*, 138, 219–229.
- Legerstee, M. (1991). The role of person and object in eliciting early imitation. *Journal of Experimental Child Psychology*, 51, 423–433.
- Lubin, L., & Field, T. M. (1981). Imitation during preschool peer interaction. *International Journal of Behavioral Development*, 4, 443–453.
- Meltzoff, A. N. (1988a). Infant imitation after a 1-week delay: Long-term memory for novel acts and multiple stimuli. *Developmental Psychology*, 24, 470–476.
- Meltzoff, A. N. (1988b). Infant imitation and memory: Nine-month-olds in immediate and deferred tests. *Child Development*, 59, 217–225.
- Meltzoff, A. N. (1990). Foundations for developing a concept of self: The role of imitation in relating self to other and the value of social mirroring, social modeling, and self practice in infancy. In D. Cicchetti & M. Beeghly (Eds.), *The self in transition: Infancy to childhood* (pp. 139–164). Chicago: University of Chicago Press.
- Meltzoff, A. N. (1995). Understanding the intentions of others: Re-enactment of intended acts by 18-month-old children. *Developmental Psychology*, 31, 838–850.
- Meltzoff, A. N., & Decety, J. (2003). What imitation tells us about social cognition: A rapprochement between developmental psychology and cognitive neuroscience. *Philosophical Transactions of The Royal Society of London B*, 358, 491–500.
- Meltzoff, A. N., & Gopnik, A. (1993). The role of imitation in understanding persons and developing a theory of mind. In S. Baron-Cohen, H. Tager-Flusberg & D. J. Cohen (Eds.), *Understanding other minds: Perspectives from autism* (pp. 335–366). New York: Oxford University Press.
- Meltzoff, A. N., & Moore, M. K. (1977). Imitation of facial and manual gestures by human neonates. *Science*, 198, 75–78.
- Meltzoff, A. N., & Moore, M. K. (1992). Early imitation within a functional framework: The importance of person identity, movement, and development. *Infant Behaviour and Development*, 15, 83–89.
- Meltzoff, A. N., & Moore, M. K. (1995). Infants’ understanding of people and things: From body imitation to folk psychology. In J. Bermúdez, A. J. Marcel & N. Eilan (Eds.), *The body and the self* (pp. 43–69). Cambridge, MA: MIT Press.
- Mitchell, R. W. (1987). A comparative developmental approach to understanding imitation. In P. P. G. Bateson & P. H. Klopfer (Eds.), *Perspectives in ethology* (Vol. 7, pp. 183–215). New York: Plenum Press.
- Moore, C., & Corkum, V. (1998). Infant gaze following based on eye direction. *British Journal of Developmental Psychology*, 16, 495–503.
- Mueller, E., & Lucas, T. (1975). A developmental analysis of peer interaction among toddlers. In M. Lewis & L. Rosenblum (Eds.), *Friendship and peer relations* (pp. 223–257). New York: Wiley.
- Nadel, J. (1986). *Imitation et communication entre jeunes enfants*. Paris: Presses Universitaires de France.
- Nadel, J., Guérini, C., Pezé, A., & Rivet, C. (1999). The evolving nature of imitation as a format for communication. In J. Nadel & G. Butterworth (Eds.), *Imitation in infancy* (pp. 209–234). Cambridge, UK: Cambridge University Press.
- Nadel-Brulfert, J., & Baudonnière, P.-M. (1982). The social function of reciprocal imitation in 2-year-old peers. *International Journal of Behavioral Development*, 5, 95–109.
- 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.
- Nielsen, M., & Dissanayake, C. (2004). Pretend play, mirror self-recognition and imitation: A longitudinal investigation through the second year. *Infant Behavior and Development*, 27, 342–365.
- Rakoczy, H., Tomasello, M., & Striano, T. (2005). On tools and toys: How children learn to act on and pretend with “virgin objects.” *Developmental Science*, 8, 57–73.

- Repacholi, B. M., & Gopnik, A. (1997). Early reasoning about desires: Evidence from 14- and 18-month-olds. *Developmental Psychology, 33*, 12–21.
- Shrout, P. E., & Fleiss, J. L. (1979). Intraclass correlations: Uses in assessing rater reliability. *Psychological Bulletin, 86*, 420–428.
- Thompson, D., & Russell, J. (2004). The ghost condition: Imitation versus emulation in young children's observational learning. *Developmental Psychology, 40*, 882–889.
- Tomasello, M. (1990). Cultural transmission in the tool use and communicatory signaling of chimpanzees? In S. T. Parker & K. R. Gibson (Eds.), *'Language' and intelligence in monkeys and apes: Comparative developmental perspectives* (pp. 274–311). Cambridge, UK: Cambridge University Press.
- Tomasello, M. (1999). *The cultural origins of human cognition*. Cambridge, MA: Harvard University Press.
- 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*, 675–735.
- Tomasello, M., Kruger, A., & Ratner, H. (1993). Cultural learning. *Behavioural and Brain Sciences, 16*, 495–552.
- Tomasello, M., & Rakoczy, H. (2003). What makes human cognition unique? From individual to shared to collective intentionality. *Mind and Language, 18*, 121–147.
- Uzgiris, I. (1981). Two functions of imitation during infancy. *International Journal of Behavioral Development, 4*, 1–12.
- Uzgiris, I. (1984). Imitation in infancy: Its interpersonal aspects. In M. Perlmutter (Ed.), *The Minnesota symposia on child psychology: Vol. 17. Parent-child interactions and parent-child relations in child development* (pp. 1–32). Hillsdale, NJ: Erlbaum.
- Uzgiris, I. (1991). The social context of infant imitation. In M. Lewis & S. Feinman (Eds.), *Social influences and socialization in infancy* (pp. 215–251). New York: Plenum Press.
- Visalberghi, E., & Limongelli, L. (1996). Acting and understanding: Tool use revisited through the minds of capuchin monkeys. In A. Russon, K. A. Bard & S. T. Parker (Eds.), *Reaching into thought: The minds of the great apes* (pp. 57–79). Cambridge, UK: Cambridge University Press.
- Wallon, H. (1934). *Les origines du caractère chez l'enfant*. Paris: Boivin & Co.
- 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.
- Want, S. C., & Harris, P. L. (2002). How do children ape? Applying concepts from the study of non-human primates to the developmental study of 'imitation' in human children. *Developmental Science, 5*, 1–13.
- Whiten, A. (2005). The second inheritance system of chimpanzees and humans. *Nature, 437*, 52–55.
- 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.
- Whiten, A., & Ham, R. (1992). On the nature and evolution of imitation in the animal kingdom: Reappraisal of a century of research. In P. J. B. Slater, J. S. Rosenblatt, G. Beer & M. Milinski (Eds.), *Advances in the study of behaviour* (Vol. 21, pp. 239–283). New York: Academic Press.

Received December 6, 2004

Revision received June 22, 2005

Accepted November 23, 2005 ■