

## Infant Imitation and Memory: Nine-Month-Olds in Immediate and Deferred Tests

Andrew N. Meltzoff

University of Washington

MELTZOFF, ANDREW N. *Infant Imitation and Memory: Nine-Month-Olds in Immediate and Deferred Tests*. CHILD DEVELOPMENT, 1988, 59, 217–225. The ability of 9-month-old infants to imitate simple actions with novel objects was investigated. Both immediate and deferred imitation were tested, the latter by interposing a 24-hour delay between the stimulus-presentation and response periods. The results provide evidence for both immediate and deferred imitation; moreover, imitative responding was not significantly dampened by the 24-hour delay. The findings demonstrate that there exists some underlying capacity for deferring imitation of certain acts well under 1 year of age, and thus that this ability does not develop in a stagelike step function at about 18–24 months as commonly predicted. These findings also show that imitation in early infancy can span wide enough delays to be of potential service in social development; actions on novel objects that are observed one day can be stored by the child and repeated the next day. The study of deferred imitation provides a largely untapped method for investigating the nature and development of recall memory in the preverbal child.

The study of infant imitation has attracted theorists from a variety of orientations. Perceptual and cognitive developmentalists are interested in imitation because the reproduction of a target act can be used to measure perception, motor control, the coordination of perception and action, and, under certain conditions, memory and representational abilities (Flavell, 1985; Meltzoff, 1985a, 1985b). Imitation has also attracted the interest of social-developmentalists, for it provides an efficient channel for early social learning. At least some of the skills of early childhood are learned via the observation of adult behavior, rather than through conditioning, trial and error, or individual maturational growth, and the origins and early development of such social learning warrant investigation (Bandura & Walters, 1963; Hartup & Coates, 1970). Finally, Piagetian psychology has focused on imitative development as playing a vital role in the transition from a purely sensorimotor level to a more representational form of intellectual organization (Flavell, 1985; Piaget, 1962).

For each of these approaches, deferred imitation takes on special importance. Cognitive theorists highlight deferred imitation as a way of investigating long-term memory in preverbal infants. Deferred imitation is rele-

vant to social theorists because the infant or child will not always be able to reproduce each adult action as soon as it is demonstrated; thus, for imitation to fulfill its social utility, the infant or child must be capable of initiating imitation long after the target display has terminated. Finally, Piagetians focus on deferred imitation as a developmental milestone that first emerges at about 18–24 months (during sensorimotor stage 6) contemporaneously with pretend play and productive language as part of a general emergence of the “symbolic function” (Inhelder, 1971; Lézine, 1973; Piattelli-Palmerini, 1980; Sinclair, 1969, 1970).

Only recently have the origins and development of deferred imitation begun to be empirically investigated. McCall, Parke, and Kavanaugh (1977) tested for deferred imitation in 1–3-year-old children, and as predicted by Piagetian theory they found that infants first began to reproduce target actions after a delay at approximately 24 months. However, two other reports suggest that, at least under certain circumstances, such behavior can be elicited at younger ages. Meltzoff (1985b) found evidence for deferred imitation after a 24-hour delay in 14-month-old infants, and Abravanel and Gingold (1985) reported imitation after a 10-min delay in 12-

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month-olds. Nevertheless there are still questions about the nature of this ability before 18–24 months. It remains possible that deferred imitation before about 18–24 months is a sharply constrained phenomenon—severely limited in the number of acts that can be retained for later reproduction, and/or in the length of delay that can be tolerated.

The work reported here was designed to assess deferred imitation at a younger age than has been tested heretofore (9-month-old infants), using a long delay period (24 hours) and a variety of tasks (three items). In addition, immediate imitation was also assessed using the same age group and the same three tasks.

The immediate test was included both as a comparison with the deferred test and as a contribution in its own right because studies of immediate imitation at this particular age have not always incorporated the control conditions necessary to distinguish imitative versus nonimitative production of the target behaviors (e.g., Uzgiris & Hunt, 1975). To isolate imitative responding, control groups that do not see the target action are needed to assess the spontaneous rate of the behavior at issue, and imitation should be inferred only if these controls produce the target behavior less than do infants who are exposed to modeling. Without such controls, the production of the matching behavior after seeing the display is not unambiguous evidence for imitation because it could be produced by chance, be facilitated by the mere presence of the adult, and/or other possibilities that are best determined by the appropriate controls (see Meltzoff, 1985b; Meltzoff & Moore, 1983, for reviews).

### Study 1

#### Method

*Subjects.*—The sample consisted of 60 9-month-old infants who were identified through the local newspapers and recruited by a telephone call. Criteria for admission into the study were no known physical, sensory, or mental handicaps, normal length of gestation (over 37 weeks), and normal birthweight (2,500–4,500 grams). The mean age at the time of test was 38.78 weeks ( $SD = 0.73$ ), and the mean birthweight was 3,645 grams ( $SD = 423$ ). Equal numbers of males and females were used. One additional subject was tested but then eliminated from the study due to excessive crying.

*Testing environment and apparatus.*—The test took place in a small room ( $3.2 \times 2.2$

m) that was unfurnished except for the experimental apparatus. During the test the infant was seated on his or her parent's lap across a small rectangular table ( $1.2 \times .76$  m) from the experimenter. Behind and to the left (1.0 m) of the experimenter was a video camera that was focused on the subject so as to include a record of the infant's torso, head, and most of the tabletop. A similar camera behind and to the right (1.0 m) of the infant recorded the adult. The videotape decks recording the experiment were housed in an adjacent viewing room to reduce auditory distractions. The experiment was electronically timed by a character generator that mixed elapsed time in 0.10-sec increments directly onto the videotaped records.

*Stimuli.*—Three novel objects designed to be highly manipulable by infants of this age were constructed from materials around the laboratory. Each object involved a different action, as described below.

The first object was an L-shaped unpainted wooden construction composed of a wooden rectangle ( $9.2 \times 10$  cm) connected by a hinge to a larger rectangular base ( $15.3 \times 23.5$  cm). The action demonstrated was to reach out and push the vertical extension over so that it lay flat on top of the base. This required a push of moderate force ( $.7 \text{ kg} \cdot \text{m/s}^2$ ), which was determined by pilot studies to be within the capacity of 9-month-olds. The second object was a small black box ( $5.4 \times 15 \times 16.5$  cm) with a black button ( $2.2 \times 3$  cm) mounted in a recess so that it lay .6 cm below the top surface of the box. The action demonstrated by the adult was pushing the button, which then activated a switch inside the box and produced a beeping sound. The beep was a rapidly pulsating tone of about 2,000 Hz, and its intensity, measured at the approximate location of the infant's head, was 61 dB Sound Pressure Level. The third object was a small orange plastic egg (6.4 cm high and 4.5 cm in diameter at its widest point) cut laterally in half and filled with a few metal nuts so that it rattled when shaken. The action demonstrated was to pick up the egg and shake it.

The hinged toy was oriented with the edge of the vertical piece facing the infant and could be pushed flat by moving it from right to left. The black box was tilted up at a slight angle ( $30^\circ$ ) by wooden supports with the top directly facing the subject. During the response period these objects were set in velcro strips to prevent them from accidentally being pushed off the table by the infant while manipulating them. For all groups, the egg

presented to the infants in the response period was identical to the one used by the model except that it did not contain any noisy fillings. This prevented any accidental rattling sounds from the infant just touching the toy.<sup>1</sup>

*Procedure.*—Upon arriving at the university, infants and parents were escorted to a waiting room where they remained for about 10–15 min while the parents completed the necessary forms. They were then brought to the test room, and the infant and male experimenter interacted by handing rubber toys back and forth across the test table until the infant seemed comfortable with the experimenter and the room. This “warm-up” period usually required 1 to 3 min, and at that point the test began.

In the imitation group ( $N = 24$ ), each infant was sequentially shown the three target actions (hinge folding, button pushing, egg rattling). The three test objects were shown one at a time in all possible test orders, balanced across the group. Each target action was demonstrated three times in a 20-sec modeling period. At the end of the three modeling periods, the infants were given a sequence of three response periods to assess whether they would reproduce the actions they saw. The objects were brought back one at a time in their original sequence and placed on a spot directly in front of the infant for a 20-sec response period starting from the infant’s first touch of the toy. If the infant became distracted during the modeling or response period, the experimenter would say “look over here” or “oh, see what I have,” but never used words relating to the tasks at hand, such as “push,” “shake,” “fold,” “copy,” or “imitate.”

The control groups (totaling 36 subjects) proceeded identically to the imitation group except that they did not see the target actions modeled. To approximate different aspects of the display, three different control groups were used: a “baseline control,” an “adult-touching control,” and an “adult-manipulation control.”

For the baseline condition ( $N = 12$ ), the modeling periods were simply omitted and the infants were timed for the three sequential 20-sec response periods with the test objects; all else was identical to the imitation condition. This control assesses the spontane-

ous probability of infants producing the target actions in the absence of previous contact with the stimuli or the modeled action. In the adult-touching condition ( $N = 12$ ), infants saw the adult reach out and hold each object three times in the modeling periods, but they were not shown the particular target actions. These control modeling periods were followed by a series of three 20-sec response periods, exactly as in the imitation and baseline conditions. This condition controls for the possibility that infants might somehow be induced into producing the target actions if they see the adult approach and touch the object, even if the exact target action was not modeled. The adult-manipulation control ( $N = 12$ ) was conducted to mimic further aspects of the target display but still without demonstrating the critical action. Infants who see that objects have consequences, that they beep or rattle, may be more motivated to manipulate them. The adult-manipulation condition demonstrated such consequences without demonstrating the target actions. For example, infants were exposed to the beeping sound made by the black box during the modeling period (as were infants in the imitation group); however, this sound was produced by having the experimenter place both his hands on the sides of the box and surreptitiously use his thumb to activate a small switch in the back of the box that was invisible to the child. Similarly, infants were exposed to the rattling sound made by the egg during the modeling period; however, this was accomplished by having the adult use one finger to spin the egg in place so that it made the sound. Finally, regarding the third object, infants were shown that the small flap could move relative to the wooden base. This was accomplished by using a toy identical to that used in the imitation condition but without the metal hinge screwed on. Infants saw the object with the flap already placed in a horizontal position (the “end state” for the flap in the imitation group), and it was then moved toward the infant and back while being held between the experimenter’s thumb and forefinger. The forward and back movement approximated the distance traversed by the arc of the flap in the imitation condition. At the end of the control modeling periods the objects were presented to the infants for the 20-sec response periods, following the same procedure as the other test conditions.

<sup>1</sup> It is possible that the infants in the imitation group might have expected the egg to make a sound when they shook it in the response period, but this should not have influenced the results because the first shaking motion was the only action scored.

