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Infants' (N = 276) ability to learn from television under seminaturalistic conditions was examined in five experiments with 12-, 15-, and 18-month-olds. In all experiments, an adult performed a series of specific actions with novel stimuli. Some infants watched the demonstration live, and some infants watched the same demonstration on television from prerecorded videotape. Infants' ability to reproduce the target actions was then assessed either immediately or after a 24-hour delay. Infants of all ages exhibited imitation when the actions were modeled live. There were age-related and task-related differences, however, in infants' ability to imitate the same actions modeled on television. The role of perceptual, attentional, and cognitive development in the ability to learn from television is discussed.

INTRODUCTION

Television is a pervasive part of Western culture. American children over the age of 6 watch television more than 2 hours per day, and children under the age of 6 watch more than 3 hours per day (Nielsen Media Research, 1997). Caregivers often use television as a babysitting strategy, and even infants and toddlers are becoming avid television viewers (Barney, 1973; Meltzoff, 1988a). By conservative estimates, children under the age of 2 are exposed to television for at least 1 hour per day (Hollenbeck & Slaby, 1979; McCall, Parke, & Kavanaugh, 1977).

In addition to its obvious role as entertainment, television is a potentially powerful teaching tool (Ball & Bogatz, 1970; Bogatz & Ball, 1971; Huston, Watkins, & Kunkel, 1989; Rice, Huston, Truglio, & Wright, 1990). Beginning in the late 1960s, there was an increase in the number of children's educational programs aimed at viewers between the ages of 3 and 6. Both laboratory-based and naturalistic studies of television viewing have shown that preschool- and early-school-age children's cognitive (Ball & Bogatz, 1970; Bogatz & Ball, 1971), language (Rice et al., 1990), and prosocial (Stein & Friederich, 1975) skills are enhanced through exposure to high-quality educational programs like *Mr. Rogers' Neighborhood* and *Sesame Street* (see also Anderson & Levin, 1976; Anderson, Lorch, Field, Collins, & Nathan, 1986; Anderson, Lorch, Field, & Sanders, 1981).

Despite the volume of research on television viewing by children, there has been only sporadic and disparate research on infants and toddlers (Hollenbeck & Slaby, 1979; Jaglom & Gardner, 1981; Lemish, 1987). The lack of systematic research on children under the age of 2 is striking, given that older infants and toddlers now constitute a distinct viewing market with programming specifically designed to capture and maintain their attention. The producers of the popular American program *Barney*, for example, advertise that their current program content is suitable for children between the ages of 1 and 8 years. Similarly, the target audience for the British program *Teletubbies* is children between the ages of 2 and 6 years. Although programs like *Barney* and *Teletubbies* undoubtedly are entertaining for infants and toddlers, the kind of information or behaviors that these very young viewers acquire from watching them is not known.

Some of the earliest work on children's ability to learn from television focused on imitation of televised behavior. In the classic studies conducted by Bandura and his colleagues, for example, 3- to 5-year-old children watched as an adult modeled a number of novel, aggressive acts using an inflatable clown. Children who were exposed to the adult model exhibited high levels of aggressive behavior toward the clown when they were allowed to play with it immediately after the demonstration (Bandura, 1965; Bandura, Ross, & Ross, 1963). Furthermore, children were as likely to imitate aggressive acts modeled on television as they were to imitate the same behavior modeled live (Bandura et al., 1963). Subsequent research has shown that children also will imitate a wide range of prosocial behaviors that they watch on television as well (for review, see Stein & Friederich, 1975).

Because they do not rely on language comprehension or production, imitation paradigms like the one used by Bandura and his colleagues provide an ideal tool for exploring what infants and toddlers learn from television (McCall et al., 1977; Meltzoff, 1988a). In one study conducted by Meltzoff (1988a), 14- and 24-month-old infants watched a video monitor as an experimenter modeled a 1-step action with a novel

toy. When tested immediately after the demonstration, infants who were exposed to the televised model were more likely than infants in the age-matched control groups to produce the target action. Furthermore, 14-month-old infants also exhibited evidence of imitation when they were tested 24 hours after the initial demonstration session; however, there was some decline in their performance relative to that of infants of the same age who were tested immediately. When the performance of infants in the Meltzoff (1988a) study was compared to that of infants who observed the same action modeled live in a previous study (Meltzoff, 1985), there was no difference in imitation as a function of model (i.e., televised or live).

In contrast, McCall et al. (1977) found that imitation of multistep sequences by 18-, 24-, and 36-month-olds was inferior following a televised demonstration relative to a live demonstration of the same actions. In fact, children's ability to imitate multistep sequences from television did not approach their ability to imitate the same actions modeled live until the age of 36 months, even when the test occurred immediately after the demonstration. Some aspects of the McCall et al. procedure, however, may have made the task extremely difficult. During the delayed test, for example, children were simultaneously presented with a large number of stimuli; half of the stimuli had been present during the original demonstration and half had not.

The overarching goal of the present research was to explore some of the conditions that might influence imitation from television during the second year of life. Our general research strategy has been heavily influenced by the research strategy adopted by Rudy and his colleagues in their empirical work on developmental changes in infant learning (Rudy, Vogt, & Hyson, 1984). The essence of Rudy et al.'s approach is that in order to understand the development of a particular psychological process, it is necessary to vary both the age of the infant and the nature of the experimental task. Thus, in the present experiments we have attempted to document not only age-related differences in performance, but by varying the requirements of our task, we also have tried to gain some understanding of age-related differences in the underlying processes.

The experimental procedure for the present experiments was designed with the child's typical television viewing conditions in mind. First, all infants were tested in their own homes, using the family television set they watched most often. Second, all of the phrases used during the demonstration were spoken at a slow pace, using short sentences that emphasized the present. Adults in television programs aimed at child audiences commonly use this conversational style (Rice & Haight, 1986). Finally, infants' attention to television is enhanced by their parents' attention to television, and many parents actively encourage their infants to attend to the information on the screen (Lemish, 1987). In the present experiments, all infants watched the demonstration with a parent and he or she was asked to alert the infant to the video display.

EXPERIMENT 1A

To date, the youngest infants tested in imitation tasks from television have been 14 months old (Meltzoff, 1988a). Recent research has shown that, under some conditions, infants as young as 6 to 12 months of age will exhibit deferred imitation of behavior modeled live (Barr, Dowden, & Hayne, 1996; Hayne, MacDonald, & Barr, 1997). The earliest age at which infants will imitate similar behaviors seen on television is not known. In Experiment 1A, we compared the imitation performance of 12-, 15-, and 18-month-old infants exposed to live or videotaped demonstrations of a novel, multistep sequence of actions. The infants' ability to reproduce the target actions was assessed for the first time following a 24-hour delay.

The imitation task used in Experiment 1A was identical to that described by Barr et al. (1996) and Hayne et al. (1997). In this task, a female experimenter demonstrated three specific actions with a puppet, and the infant's ability to reproduce those actions was assessed for the first time following a delay. One strength of this task is that baseline performance of the target actions is developmentally invariant between 6 and 24 months of age (Barr et al., 1996; Hayne et al., 1997). This invariance makes it possible to assess developmental differences in deferred imitation per se across a wide age range during the infancy period. Furthermore, for all age groups, the spontaneous production of the target behaviors was virtually zero. In the past, imitation of zero-probability behaviors has been a hallmark test of deferred imitation (Masur & Ritz, 1984; Meltzoff, 1988a; Piaget, 1962; Uzgiris & Hunt, 1975).

METHOD

Participants

In all of the present experiments, infants were recruited from public birth records and by word of mouth; the majority of infants were Pakeha (New Zealanders of European decent) and came from a wide range of socioeconomic backgrounds. One hundred and eight infants participated in Experiment 1A.

Thirty-six infants (18 female) were 12 months old (M = 12.29, SD = 0.12), 36 (18 female) were 15 months old (M = 15.22, SD = 0.19), and 36 (18 female) were 18 months old (M = 18.26, SD = 0.25). Three additional 12-month-olds were excluded from the final sample due to illness, interruptions, or scheduling difficulties. Five additional 15-month-olds were excluded from the sample due to illness or interruptions. Six additional 18-month-olds were excluded from the final sample due to illness, interruptions, equipment failure, or walking away during the demonstration.

Apparatus

Two hand puppets, a pastel pink rabbit and a pale grey mouse, were constructed for these experiments and were not commercially available. Both puppets were 30 cm in height and were made of soft, acrylic fur. A removable felt mitten (8 cm × 9 cm) was placed over the right hand of the puppet. The mitten was either pink or gray and matched the color of the rabbit or mouse, respectively. A large jingle bell was secured to the back of the puppet (control condition) or inside the mitten itself (demonstration condition). The puppets (mouse or rabbit) were counterbalanced across conditions.

Procedure

The procedures used in Experiment 1A were identical to those used in our past research on the development of deferred imitation (Barr et al., 1996; Hayne et al., 1997). All infants were tested in their own homes at a time of day when they were likely to be alert and playful. The demonstration session and the test session were separated by 24 hours (±5). At the beginning of each session, the infant was placed on the caregiver's knee and was held firmly by the hips. The experimenter interacted with the infant for approximately 5 min or until a smile was elicited.

Demonstration session. Infants were randomly assigned to one of three groups, the *live group*, the *video group*, or the *control group.* During the demonstration session, infants in the *live group* watched the female experimenter perform three specific actions with a puppet. The female experimenter knelt down in front of the infant and caregiver, and said "hello" to the infant. She then placed the puppet over her right hand. The puppet was positioned at the infant's eye level but was out of reach, 80 cm from the infant's chest. If the infant failed to orient toward the experimenter, the experimenter attracted his or her attention by saying "look," and using the child's name. The experimenter then removed the mitten from the puppet's right hand, shook it three times ringing the bell inside, and replaced it on the puppet's right hand. This sequence was repeated two more times. When the demonstration was complete, the experimenter said "goodbye," and the session ended. The entire demonstration session lasted approximately 60 s.

Infants in the *video group* watched the same female experimenter perform the same target actions with the puppet; however, these actions were demonstrated on prerecorded videotape. The video demonstration was identical to the live demonstration. The experimenter placed the videotape in the video recorder, and left the room. Once the experimenter was gone, the caregiver started the videotape. Prior to her departure from the room, the experimenter instructed the caregiver to direct the infant's attention to the television screen using only the child's name and the word "look." Caregivers also were asked to refrain from narrating the actions on the television screen.

At the beginning of the prerecorded videotape, the female experimenter walked into the picture from off-camera, knelt down in front of the camera, and said "hello." She then placed the puppet over her right hand. Her torso, part of her face, and the whole puppet were visible on the screen. The actions were then demonstrated in a manner identical to that for infants in the live group. When the demonstration was complete, the experimenter said "goodbye," and the tape ended. The total duration of the videotape (including "hello" and "goodbye") was 60 s. Once the video demonstration was complete, the experimenter returned to the room and removed the videotape from the recorder. Although the experimenter who visited the infant was also the experimenter on the videotape, at no time was the infant simultaneously confronted with the live experimenter and her video image.

Infants in the *control group* were exposed to the puppet, the mitten, the ringing of the bell, and the experimenter for the same amount of time as infants in the live and video groups, however, the mitten was never removed and the target actions were never demonstrated. For infants in the control group, the jingle bell was attached to the back of the puppet's body. As before, the puppet was held in front of the infant but was out of reach. The experimenter shook the puppet three times ringing the bell attached to the puppet's back. This procedure was repeated two more times.

The experimenter's verbal comments during the demonstration session were scripted such that the timing and the content of the comments were identical

for infants in all groups (live, video, control). For infants in all three groups, the demonstration session began with "hello" and ended with "goodbye." To maintain the infants' attention during the demonstration session, the experimenter used phrases like, "isn't this fun?" or "are you still watching?" or "shall we have another look?" These phrases were inserted prior to each successive removal of the mitten (live, video) or prior to each successive shake of the puppet (control). In none of the groups were the target actions or the puppet ever labeled.

Test session. The test session was scheduled 24 hours (±5) after the demonstration session and was identical for infants in all three groups. All infants were tested by the same experimenter with the same puppet that they had seen the day before. During the test, the bell was removed from the back of the puppet or from inside the mitten and the puppet was placed within reach, approximately 30 cm in front of the infant. The test session was videotaped.

Two independent observers scored each videotaped test session. One observer was blind to the infants' group assignments. Infants were allowed 90 s from the time they first touched the puppet in which to imitate the target actions. Both observers noted the presence or absence of three target behaviors during the test: (1) remove the mitten (2) shake the mitten, and (3) put (or attempt to put) the mitten back on the puppet. Both percent reliability and kappa were calculated yielding an interobserver reliability of 95% ($\kappa = .91$).

Results and Discussion

An imitation score was calculated for each infant by summing the number of target behaviors that he or she produced during the test (*range* = 0–3). The mean imitation score of the infants in each group (control, video, live) is shown in Figure 1 as a function of age. The data were subjected to a 3 × 3 (age × group) analysis of variance (ANOVA). Post hoc comparisons were made using Student-Newman-Keuls tests, $p < .05$. There was a main effect of age, $F(2, 99) = 5.85$, $p < .005$. The scores of the 18-month-olds were significantly higher than the scores of the 12- and 15-month-olds, and the scores of these latter two age groups were not different (see Figure 1). There also was a main effect of group, $F(2, 99) = 31.45$, $p < .001$. Overall, infants in the live group had higher scores than infants in the other two groups. Furthermore, infants in the video group had higher scores than infants in the control group. There was no significant age × group interaction.

Next, in order to determine the demonstration conditions under which infants of each age exhibited imitation, the imitation scores of infants in the live and video groups were compared to that of their age-matched control group (cf. Meltzoff, 1985). Separate Bonferroni planned comparisons, $p < .05$, indicated that at all three ages, infants in the live group had higher imitation scores than infants in their age-matched control group (see Figure 1). In the video group, however, only the 18-month-olds had imitation scores that were significantly higher than the scores of their age-matched control group (see Figure 1). The imitation scores of the 12- and 15-month-olds in the video group were not different from those of their respective control groups. In fact, only 1 of the 12-month-olds and 1 of the 15-month-olds in the video group imitated any of the target actions during the test.

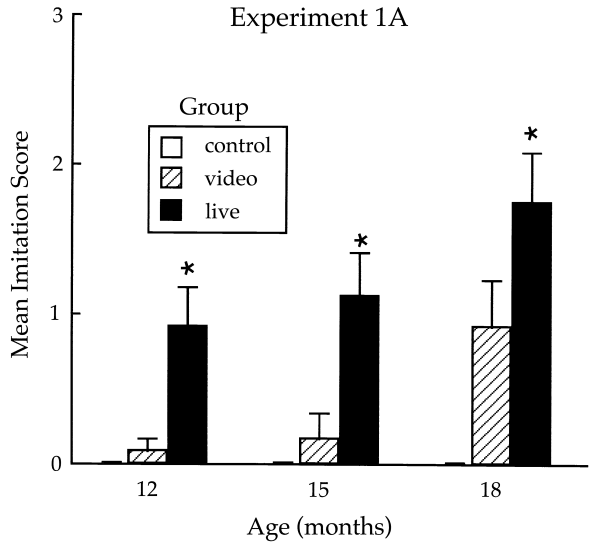

Figure 1 The mean imitation scores (+1*SE*) of infants in Experiment 1A as a function of age and experimental group (control, video, live). An asterisk indicates that the mean imitation score of an experimental group is significantly different from that of their age-matched control group.

Note that in the present experiment, no infant in the control group imitated any of the target actions during the test, therefore, the variance within the control groups was zero. To determine whether violation of the assumption of homogeneity of variance biased our conclusions in any way, we also assessed the performance of infants in the two experimental groups relative to their age-matched controls using nonparametric procedures (Wilcoxon-Mann-Whitney Rank Sum test; Siegel & Castellan, 1988). The results of these nonparametric analyses were identical to those obtained using standard parametric procedures.

The present findings demonstrate an age-related change in imitation of actions modeled on television.

Although infants of all ages exhibited some evidence of deferred imitation after a 24-hour delay following a live demonstration, infants younger than 18 months of age exhibited no imitation whatsoever following the video demonstration of the same actions. Furthermore, although 18-month-olds imitated some target actions following a video demonstration, their imitation performance was still inferior to the performance of their age-matched counterparts who watched the same demonstration live.

EXPERIMENT 1B

In order to exhibit imitation following a delay, infants must encode information about the target actions and remember that information over a delay. Given these requirements, one of two factors may have precluded the 12- and 15-month-old infants in Experiment 1A from imitating the actions when they were modeled on television. Infants in the video group may not have encoded sufficient information about the target actions during the video presentation, or they may have forgotten that information over the 24-hour delay. In Meltzoff's (1988a) study, for example, 65% of the 14-month-old infants imitated the target action when they were tested immediately after the demonstration; however, only 40% of the infants imitated the same action after a 24-hour delay. To determine the relative contributions of encoding and forgetting, we examined whether or not 12- and 15-month-olds would imitate the target actions if we eliminated the retention interval between the video demonstration and the test.

Method

Participants

Seventy-two infants participated in Experiment 1B. Thirty-six infants (18 female) were 12 months old (M = 12.30, SD = 0.14) and 36 infants (18 female) were 15 months old (M = 15.23, SD = 0.13). Four additional 12-month-old infants were excluded from the final sample due to interruptions during the test session. Six additional 15-month-old infants were excluded from the final sample due to interruptions, equipment failure, or failure to attend to the demonstration.

Apparatus, Demonstration, and Test

The apparatus was identical to that described in Experiment 1A. The demonstration and test procedures for infants in the live and video groups were identical to those used in Experiment 1A, except that the test occurred immediately after the demonstration rather than after a 24-hour delay.

In all of our past research with this task (Barr et al., 1996; Hayne et al., 1997; Experiment 1A), spontaneous production of the target actions had been assessed using a nondemonstration control procedure. In this procedure, the experimenter performed a different action (i.e., shaking the puppet) to produce the same outcome (i.e., ringing the bell). If, during the test, infants in the nondemonstration control procedure attempt to imitate that action, then this particular control procedure may underestimate spontaneous production of the target actions by infants with no exposure to the puppet prior to the test. In Experiment 1B, therefore, a different control condition was used. Infants in the baseline control group were presented with the puppet for the first time at the time of the test. That is, they had no exposure to the puppet or to the experimenter prior to the test (see also Barnat, Klein, & Meltzoff, 1996; Hanna & Meltzoff, 1993; Meltzoff, 1985, 1988a, 1988b).

As before, infants in the live, video, and control groups were allowed 90 s from the time they first touched the puppet in which to imitate the target actions during the test. A trained observer scored each videotaped test session. A second trained observer, blind to the infants' group assignments, scored 99% of the test sessions. Interobserver reliability was 99% (κ = 0.98).

Results and Discussion

The mean imitation score of the infants in each group (control, video, or live) is shown in the left panel of Figure 2 as a function of age. The data presented in the left panel of Figure 2 were subjected to a 2 × 3 (age × group) ANOVA. This analysis yielded a main effect of group, $F(2, 66) = 23.46$, $p < .001$. Post hoc Student-Newman-Keuls tests, $p < .05$, indicated that infants in the live group exhibited significantly higher imitation scores than infants in the video or control groups, and these latter two groups did not differ. There was no significant main effect of age and no age × group interaction.

As in Experiment 1A, separate Bonferroni planned comparisons, $p < .05$, were conducted at each age to compare the imitation scores of infants in the experimental groups (live and video) with that of their age-matched control group. At both ages, the mean imitation score of infants in the live group was higher than the mean imitation score of infants in their age-matched baseline control group (see Figure 2). At neither age was the imitation score of the infants in the video group significantly different from that of their

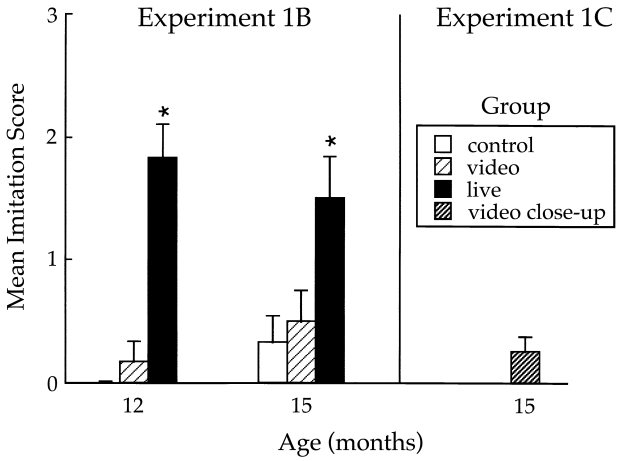

Figure 2 The mean imitation scores (+1*SE*) of infants in Experiment 1B (*left panel*) and 1C (*right panel*) as a function of age and experimental group (control, video, live, video close-up). An asterisk indicates that the mean imitation score of an experimental group is significantly different from that of their age-matched control group.

age-matched baseline control group. The results of nonparametric analyses were identical to those obtained using standard parametric procedures.

In Experiment 1A and 1B, two different control procedures were used to estimate spontaneous production of the target behaviors. Infants in the nondemonstration control group (Experiment 1A) were exposed to the test stimuli for the same amount of time as infants in the demonstration conditions, but they were not shown the target actions prior to the test. In contrast, infants in the baseline control group (Experiment 1B) did not see the test stimuli at all prior to the test session. On the test day, infants in both control groups were treated in an equivalent manner. To assess potential differences in the two control conditions, the test performance of infants in the nondemonstration control group (Experiment 1A) and the baseline control group (Experiment 1B) was compared at each age using independent *t* tests. At neither 12 nor 15 months of age was there a significant difference between the performance of the two control groups.

The results of Experiment 1B replicate and extend a number of findings reported in Experiment 1A. First, there was no age-related change in the spontaneous production of the target actions, even when performance was assessed using a different, potentially more conservative, control procedure. Second, both 12- and 15-month-olds imitated the target actions following a live demonstration with no age-related change in performance. Third, 12- and 15-month-old infants did not imitate the target actions following a video demonstration even when there was no delay between the demonstration and the test. This latter finding rules out the possibility that the failure of 12- and 15-month-olds to imitate the target actions from television in Experiment 1A was due to forgetting.

EXPERIMENT 1C

In light of the results of Experiment 1B, it now seems likely that infants in the video group failed to encode sufficient information about the target actions from the video demonstration in the first place. One possible explanation for this failure may have been that some aspect of the original video (e.g., the experimenter's face, the unfamiliar room in which the demonstration was filmed) may have distracted infants from the more relevant aspects of the demonstration. In order to maximize the probability that infants in the video group attended to the relevant portion of the demonstration, we made another videotape of the demonstration that included close-up shots of the puppet during the demonstration of the target actions. Infants' ability to imitate the target actions immediately after this video demonstration was assessed in Experiment 1C.

Method

Participants

Twelve (six female) 15-month-old (M = 15.18, SD = 0.19) infants participated in Experiment 1C. One additional 15-month-old infant walked away during the test session and was excluded from the final sample.

Apparatus, Demonstration, and Test

Two videotapes were made specifically for Experiment 1C. One video showed the experimenter demonstrating the target actions with the rabbit puppet and the other video showed her demonstrating the target actions with the mouse puppet. These prerecorded videotapes were identical to the ones used in Experiment 1A and 1B, except that during the demonstration of the target actions a close-up of the puppet was shown. The initial shot showed a wide-angle view of the experimenter and the puppet. At the beginning of the demonstration of the target actions, however, the camera zoomed in to show a close-up of the puppet. At the end of the demonstration of the target actions, the camera zoomed out to show the original wide-angle view of the experimenter and the puppet.

All infants were tested immediately after the dem-

onstration. As before, infants were allowed 90 s from the time they first touched the puppet in which to imitate the target actions during the test. Each test session was scored by two trained observers, one of whom was blind to the infants' experimental condition. Interobserver reliability was 100% ($\kappa = 1.00$).

Results

The mean imitation score of the infants in the video group (close-up) is shown in the right panel of Figure 2. The imitation scores of infants in the video group (close-up) were compared to those of the 15-month-old infants in the baseline control group from Experiment 1B using a *t* test. As shown in Figure 2, the mean imitation score of infants in the video group (close-up) was not different from the mean imitation score of infants in the baseline control group, $t(22) = .36$, $p < .7$. That is, 15-month-old infants did not imitate the target actions following a video demonstration even when presented with a video close-up of the target actions.

Discussion

Taken together, the present findings demonstrate that although 12-, 15-, and 18-month-old infants imitated actions that were modeled live, only 18-month-old infants imitated the same actions when they were modeled on television. Even when tested immediately after the standard video demonstration or immediately after the close-up version of the video, infants younger than 18 months did not imitate actions presented on television. The findings obtained with the 15-month-old infants, in particular, stand in stark contrast to those previously reported by Meltzoff (1988a). In his original study, 14-month-olds imitated an action modeled on television, whereas in Experiments 1A, 1B, and 1C, we found no evidence of imitation whatsoever by 15-month-old infants.

One potential explanation for the discrepancy between the findings reported here and those previously reported by Meltzoff (1988a) is the differing level of difficulty of the imitation tasks used in the two sets of experiments. For example, 14- and 16-month-olds have been shown to exhibit retention of the unique 1-step action used in Meltzoff's (1988a) study when they are tested after a 4-month delay (Meltzoff, 1995). In contrast, we have found that even 18-month-olds exhibit no retention of the multistep actions modeled with the puppet when they are tested after delays longer than 4 weeks (Barr & Hayne, in press). Furthermore, during the initial demonstration session with the puppet, infants never actually saw the bell. At the time of the test, the bell also was not perceptually available. From this perspective, infants were required to remember the location (i.e., inside the mitten) of a hidden object.

EXPERIMENT 2

For the next experiment, we developed a new imitation task that was potentially easier than the puppet task used in the preceding experiments. In the new task, the experimenter made a rattle by placing a block in a jar, putting a lid on the jar, and shaking a handle attached to the lid to make a sound. This task was modeled after one originally developed by Bauer and colleagues (e.g., Bauer, Hertsgaard, & Wewerka, 1995; Bauer & Shore, 1987). Unlike the puppet task, the stimuli required to solve the rattle task are visible during all stages of the demonstration and the test. Furthermore, Bauer has shown that 17½-month-olds will imitate these target actions following a delay of at least 6 weeks (Bauer & Shore, 1987). In Experiment 2, we used the "rattle" stimuli to assess imitation by 15-month-olds. We predicted that, when tested with an easier task, infants of this age would imitate the actions whether they were modeled live or on television. Furthermore, to provide additional information about possible differences between conditions, we measured infants' attention during the live and video demonstrations, from video recordings of infants' behavior during the original demonstration session.

Method

Participants

Thirty-six (20 female) 15-month-old ($M = 15.22$, $SD = 0.17$) infants participated in Experiment 2. One additional 15-month-old infant was excluded from the final sample due to failure to attend to the demonstration.

Apparatus and Procedure

The stimuli used for Experiment 2 are shown in the top right corner of Figure 3. As before, all infants were tested in their own homes at a time of day when they were likely to be alert and playful.

Demonstration. Infants were randomly assigned to one of three groups (live, video, or control). For infants in the *live group*, the female experimenter performed three specific actions with the "rattle" stimuli. First, she put the block in the jar, then she

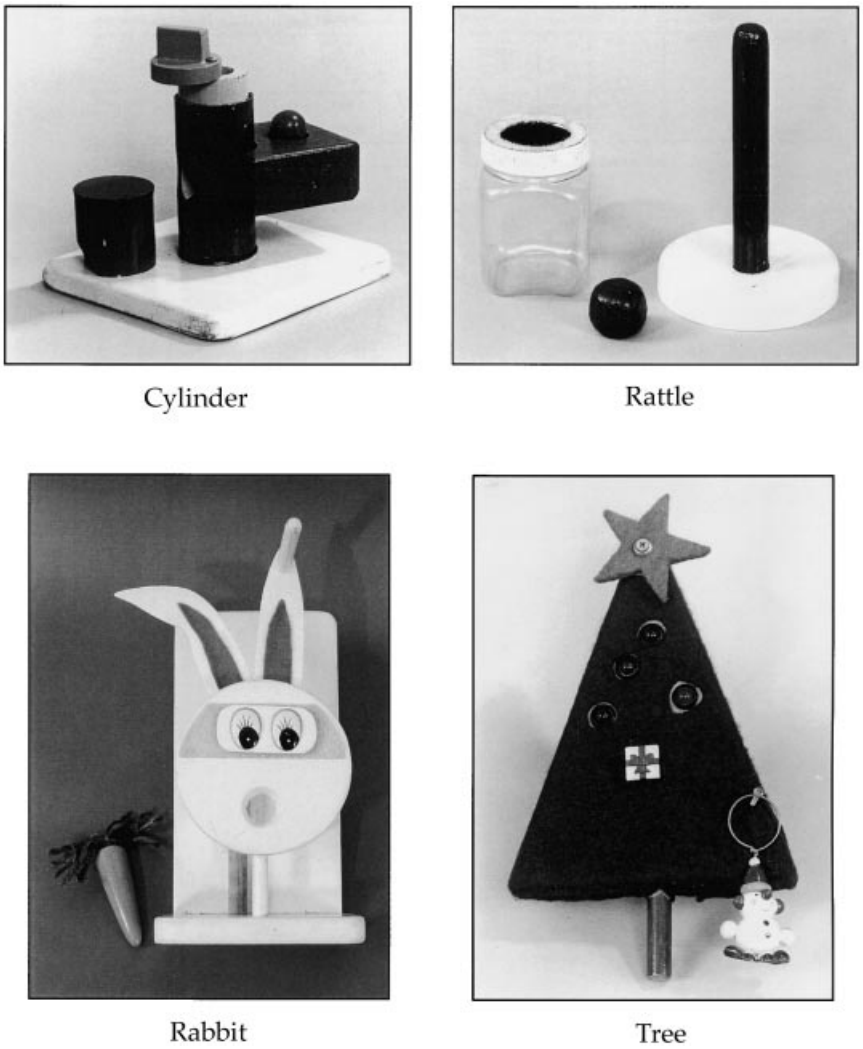

Figure 3 The stimuli used in Experiments 2 and 3. For each set of stimuli, the experimenter modeled a 3-step sequence of actions (see Table 1).

put the stick on the jar (velcro held them together), and then she shook the stick to make a sound. These three actions were demonstrated a total of three times; the actions were always demonstrated in the same order.

Infants in the *video group* watched the same experimenter perform the same target actions on a prerecorded videotape. The female experimenter's torso, her face, and the stimuli were visible on the screen. The actions were then demonstrated in a manner identical to that for infants in the live group. The experimenter placed the video in the video recorder and left the room. The caregiver started the tape. After the videotaped demonstration was complete, the experimenter returned to the room and removed the videotape from the recorder. Finally, infants in the *baseline control group* had no exposure to the stimuli prior to the test.

Test. The test session occurred immediately after the demonstration and was identical for infants in all three groups. During the test, infants were allowed 60 s from the time they first touched the stimuli in which to imitate the target actions. Note that the test period for Experiment 2 (60 s) was shorter than the test period in Experiment 1 (90 s), because the task was designed to be easier. Rescoring the data from Experiment 2 using a 90-s test period similar to that used in Experiment 1 did not alter the results.

Each infant's behavior was videorecorded during both the demonstration and the test. To assess potential differences in infants' attention to the live and video demonstrations, two trained observers

Table 1 The Target Actions for the Three-Step Sequences used in Experiments 2 and 3

Stimulus	Step 1	Step 2	Step 3
Rattle	Push block through diaphragm into jar	Put stick on jar (velcro holds them together)	Shake stick to make rattle
Cylinder	Remove green lid from green cylinder to reveal orange lid	Twist orange lid open to reveal yellow cylinder	Put ball into the top of the yellow cylinder to make it come out the bottom hole
Rabbit	Pull lever in a circular motion to raise ears	Place eyes on face (velcro sticks them on)	Feed rabbit the carrot in the hole
Tree	Push present with index finger to activate lights	Spin the star	Hang the snowman on the tree

scored each videotape to determine the percentage of time infants spent looking at the demonstration of the target actions. A Pearson product-moment correlation yielded an interobserver reliability coefficient of .94 ($p < .001$). In addition, one observer noted the number of times each infant vocalized during the demonstration or pointed and reached toward the stimuli.

Two trained observers also scored each infant's test performance. As before, one observer was blind to the infants' group assignment. Both observers noted the presence or absence of the three target behaviors: (1) put the block in the jar, (2) put the lid on the jar, and (3) shake the stick. Interobserver reliability was 97% ($\kappa = 0.93$).

Results and Discussion

Looking Scores

The percentage of available time infants in the live and video groups spent looking at the demonstration were compared using a t test. The results of this analysis indicated that there was no significant difference in looking during the demonstration as a function of experimental condition (video: $M = .92$, $SE = .03$; live: $M = .98$, $SE = .01$). Infants in the video group were more likely to vocalize during the demonstration ($M = 1.09$ times, $SE = .37$) than infants in the live group ($M = 0$ times, $SE = 0$), $t(20) = 2.62$, $p < .05$. In contrast, infants in the live group were more likely to point or reach toward the stimuli ($M = 2.18$ times, $SE = .52$) than infants in the video group ($M = .64$ times, $SE = .28$), $t(20) = 2.96$, $p < .01$.

Imitation Scores

The mean imitation score of infants in each group (control, video, live) is shown in Figure 4 as a function of group. The data presented in Figure 4 were subjected to a one-way ANOVA across experimental group. There was a main effect of group, $F(2, 33) = 8.34$, $p < .001$. Post hoc Student-Newman-Keuls tests, $p < .05$, indicated that there was no significant difference in the imitation scores of infants in the live and video groups. Furthermore, the mean imitation scores of both groups were significantly higher than those of infants in the baseline control group. That is, when tested with an easier task, the infants in the video and live conditions performed equivalently.

EXPERIMENT 3

Taken together, our findings and those reported by Meltzoff (1988a) indicate that, under some circumstances, 14- to 18-month-old infants can encode information they see on television and can use that infor-

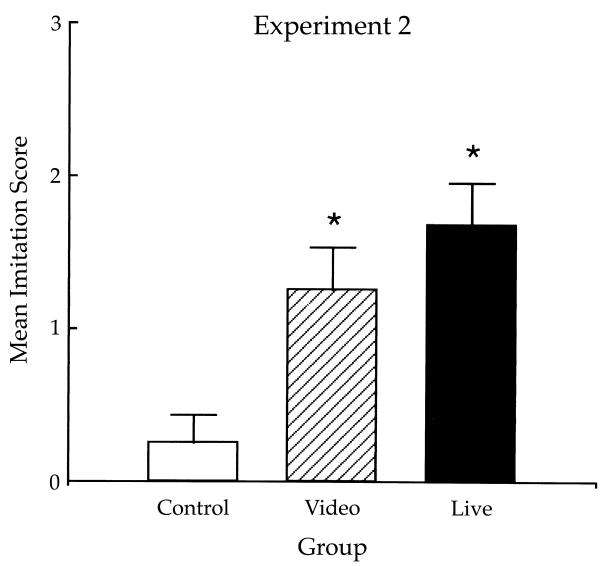

Figure 4 The mean imitation scores (+1*SE*) of the 15-month-old infants in Experiment 2 as a function of experimental group (control, video, live). An asterisk indicates that the mean imitation score of an experimental group is significantly different from that of their age-matched control group.

mation to perform actions with the three-dimensional objects during the test. Presumably, a number of factors influence the probability that infants of a given age will acquire information from television. Our findings show that one of these factors is the difficulty of the task per se. Another factor may be the way in which the target information is embedded within a program or program segment. In all of the experiments conducted to date on infant imitation from television, the video demonstrations have been extremely sterile relative to television programs designed for young children. Whether or not infants can acquire and remember information under these more complex viewing conditions is not known. On the one hand, infants may find it more difficult to imitate actions that are embedded in a more complex series of events; on the other hand, more complex viewing conditions might make the demonstration richer and more interesting, thus enhancing infants' attention and their tendency to imitate.

In our final experiment, we made the features of our video demonstration more similar to the features common to many children's programs and assessed infants' ability to imitate the target actions after a delay. First, although children's television programs are composed of a number of short segments, these segments are typically longer than the 1-min video presentation used in our previous experiments (e.g., Rice & Haight, 1986). In Experiment 3, the total duration of the video demonstration was increased to 3 min. To do this, we demonstrated two different 3-step sequences with two different sets of stimuli. Second, most network programs for children are preceded, interrupted, and followed by commercials. Even programs that air on public television are typically preceded by information that is unrelated to the program per se. In Experiment 3, a 1-min commercial was added to the beginning of the video demonstration. Third, infants rarely encounter the people they see on television. In Experiment 3, the adult model on the videotape was different from the experimenter who visited the infants in their homes (see also Meltzoff, 1988a). Fourth, infants may not have immediate access to the objects that they see on television. Under these conditions, they must remember the target actions over a delay. In Experiment 3, infants were tested 24 hours after the original demonstration. Finally, television programs typically involve the use of different camera angles to present various aspects of the same scene (e.g., Greenfield, 1984; Huston & Wright, 1983). In Experiment 3, different camera angles were used to show the adult model and the target actions during the demonstration (see also McCall et al., 1977).

Method

Participants

Forty-eight infants participated in Experiment 3. Twenty-four infants (12 female) were 15 months old (M = 15.25, SD = 0.15) and 24 infants (12 female) were 18 months old (M = 18.30, SD = 0.23). Eleven additional 15-month-old infants were excluded from the final sample due to failure to attend to the demonstration, equipment failure, scheduling difficulties, maternal or sibling interference, or procedural error. Seven additional 18-month-old infants were excluded from the final sample due to illness, equipment failure, or failure to attend to the demonstration.

Apparatus

In addition to the "rattle" stimuli used in Experiment 2, we constructed three additional sets of stimuli (see Figure 3) and target actions (see Table 1, for Experiment 3. The stimuli and target actions were selected for this experiment based on extensive pilot testing. The level of difficulty of the new target actions was designed to be similar to those required for the "rattle."

Four prerecorded videotapes were made for Experiment 3. The same female experimenter modeled two 3-step sequences on each videotape. The set of stimuli and their order of presentation were counterbalanced across videotapes. Each videotape was 3 min in duration.

Procedure

All infants were tested in their own homes at a time of day when they were likely to be alert and playful. The demonstration session and test session were separated by 24 hours (±5).

Demonstration session. For each infant, two sets of stimuli were used to assess the spontaneous production of the target actions (baseline phase), and the other two sets were used to assess imitation following the delay (test phase). During the baseline phase, infants were presented with two sets of stimuli, one set at a time, and their behavior was recorded for a 60-s period with each set of stimuli. The remaining two sets of stimuli were then used to model two target sequences three times each.

Infants were randomly assigned to the *live group* or the *video group.* For infants in the live group, the female experimenter began the live demonstration by saying "hello." She then demonstrated three specific actions with two different sets of stimuli (see Table 1). She demonstrated the target actions for the first

set of stimuli three times and then she demonstrated the target actions for the second set of stimuli. The target actions were always demonstrated in the order shown in Table 1. When the demonstration was complete, the experimenter said "goodbye," and the session ended.

Infants in the *video group* watched as a different experimenter performed the same three specific actions with the sets of stimuli on prerecorded videotape. At the beginning of the videotape, a 1-min commercial advertisement was recorded. Following the commercial, infants saw the torso of the female experimenter standing in front of a table. The experimenter began the video demonstration by saying "hello." Next, infants saw a close-up of the experimenter's hands as she modeled the target actions (see also McCall et al., 1977). Next, they saw the torso of the female experimenter again. The demonstration alternated between close-ups of the target actions and the torso of the female experimenter. As in the live condition, the experimenter on the video demonstrated the actions with one set of stimuli three times and then demonstrated different actions with the other set of stimuli. The actions were demonstrated in exactly the same manner as for infants in the live group. Between the presentation of one set of stimuli and the other, there was a 10 s fade out to black. When the video demonstration was complete, the experimenter said "goodbye," and the tape ended. For infants in both the video and the live condition, the target actions and the stimuli were never labeled or described.

Test session. The test session was scheduled 24 hours (±5) after the demonstration and was identical for infants in both groups. Each infant was tested with the same sets of stimuli that he or she had seen during the demonstration the day before. The stimuli were re-presented in the same order in which they had been presented during the demonstration session. As in Experiment 2, the test period for each set of stimuli was 60 s. The infant was given the first set of stimuli and his/her behavior was recorded for 60 s. The infant was then given the second set of stimuli, and behavior was recorded for an additional 60 s.

Two independent observers coded each videotaped test session. One observer was blind to the infants' group assignment. Both observers noted the presence or absence of each of the target actions for each set of stimuli. Interobserver reliability was 95% ($\kappa = .93$).

Results and Discussion

Preliminary ANOVAs indicated that there was no effect of stimulus set on either baseline or test performance. For this reason, the data were collapsed across stimulus sets for all subsequent analysis.

The mean number of target actions are shown in Figure 5 as a function of age, group (live, video), and phase (baseline, test). The data presented in Figure 5 were subjected to a 2 × 2 × 2 (age × group × phase) ANOVA with repeated measures over phase. This analysis yielded a main effect of age, $F(1, 44) = 18.59$, $p < .001$, group, $F(1, 44) = 7.44$, $p < .01$, and phase, $F(1, 44) = 86.80$, $p < .001$. These main effects were qualified, however, by a number of higher-order interactions (age × phase: $F(1, 44) = 7.88$, $p < .01$; group × phase, $F(1, 44) = 23.3$, $p < .001$; age × group × phase, $F(1, 44) = 5.56$, $p < .01$).

To evaluate the three-way interaction, 2 × 2 (age × group) ANOVAs were calculated for the baseline and test phases, separately. During the baseline phase, there were no differences in the spontaneous production of the target actions as a function of age or test group (see Figure 5, open bars). During the test phase, however, there was a significant main effect of age, $F(1, 44) = 23.35$, $p < .001$, a significant main effect of group, $F(1, 44) = 23.35$, $p < .001$, and a significant age × group interaction, $F(1, 44) = 4.93$, $p < .05$ (see Figure 5, solid bars). Post hoc Student-Newman-Keuls tests, $p < .05$, indicated that, during the test, the 18-month-old infants in the live group exhibited the highest imitation scores. The scores of the 18-month-old infants in the video group and the 15-month-olds in both the live and the video groups did not differ from one another.

In order to examine the conditions under which in-

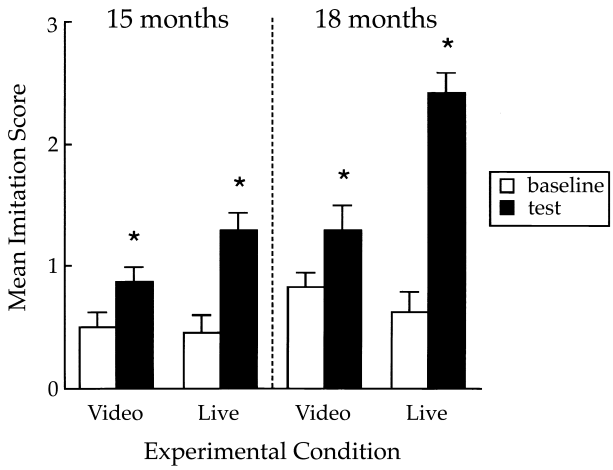

Figure 5 The mean imitation scores (+1*SE*) of infants in Experiment 3 as a function of age, experimental group (video, live), and test phase (baseline, test). An asterisk indicates that the mean imitation score of the group was significantly different from baseline.

fants of each age exhibited evidence of deferred imitation, separate Bonferroni planned comparisons, $p < .05$, were conducted at each age comparing the total number of target actions performed during baseline and during the test. At each age, infants in both the live and the video group performed significantly more target actions during the test than they performed during baseline. That is, although the 18-month-olds in the live group had the highest scores overall, infants of both ages in both groups exhibited some evidence of deferred imitation during the test (see Figure 5).

Taken together, the results of Experiment 3 indicate that 15- and 18-month-old infants will imitate a video model even when the video presentation is more similar to the complex viewing conditions common to real television programs and even when they are tested following a 24-hour delay. Under these complex viewing conditions, however, the performance of infants in the video condition in Experiment 3 was consistently inferior to that of infants in the live condition.

GENERAL DISCUSSION

The present series of experiments was designed to investigate developmental changes in infants' ability to learn from television under seminaturalistic conditions. One of the most consistent findings from the present study was that infants' ability to imitate actions following a live demonstration was superior to their ability to imitate the same actions modeled on television. Only in Experiment 2, when the imitation task was designed to be easy, when the viewing conditions were extremely sterile, and when the test occurred immediately after the demonstration, was infants' ability to imitate actions on television equivalent to their ability to imitate the same actions modeled live.

The present findings are highly consistent with two recent studies of young children's ability to use television as a source of information in other tasks. In one study conducted by Troseth and DeLoache (1998), for example, 2 ½-year-olds successfully located objects hidden in a room after watching an experimenter hide the objects via an online video monitor. Two-year-olds, on the other hand, could not use information from the video presentation to locate the objects in the real room even when they were provided with extensive orientation regarding the relation between the online television picture and the test room. The pattern of results reported by Troseth and DeLoache has recently been replicated in another laboratory (Schmitt, 1997). In the Schmitt study, 2- and 2½-year-old children were much less accurate in locating an object if they watched it being hidden on television rather than through a window. It was not until the age of 3 years that children's performance was equivalent in the two conditions.

Taken together, studies of imitation conducted with infants and studies of search behavior conducted with children demonstrate that the ability to use information presented on television lags behind the ability to use the same information presented live. Given the large amount of time that infants and children spend watching television, why do they find it difficult to use television as a source of information to solve tasks in the real world?

A number of factors may contribute to this developmental lag in performance. First, the perceptual characteristics of television per se may hinder the performance of infants and young children. The two-dimensional nature of television reduces the number of visual cues contained in the image (e.g., motion parallax, texture, depth). In one of the experiments conducted by Troseth and DeLoache (1998), however, 2-year-olds were allowed to watch the hiding task on television, but were led to believe that they were watching it live through a window. Although the video demonstration was still two-dimensional, a number of the 2-year-old children successfully completed the search task. This finding suggests that young children's difficulty in using television as a source of information is not due exclusively to the lack of visual information contained in the televised material.

Second, infants and young children may find it difficult to learn from television simply because of the reduced size of the experimental stimuli in the televised image. In Experiment 1A of the present study, for example, the visual angle for the live demonstration was 21.2°, whereas the visual angle for the video demonstration ranged from 4.7° to 8.7°, depending upon the size of the infants' television. Although the retinal image of the puppet in the live demonstration was considerably larger than the retinal image of the puppet in the video demonstration, there is no simple relation between visual angle and infants' performance. For example, in Experiment 1C, the visual angle of the puppet was increased (*range* = 9.7°–16.7°) by adding close-ups during the video demonstration. Under these viewing conditions, however, 15-month-olds still failed to imitate the target actions. In Experiments 2 and 3, on the other hand, the visual angle of the stimuli in the video condition ranged from 3.7° to 16.7°, yet infants of the same age imitated the target actions following the video demonstration.

Third, it is possible that infants and young children may have imitated fewer behaviors in the video condition because of the discrepancy between the

size of the televised stimuli and the size of the stimuli presented during the test session. In all of the research conducted to date, the size of the stimuli during the demonstration was identical to the size of the stimuli during the test only for participants in the live condition. In the video condition, on the other hand, the stimuli encountered during the test were considerably larger than those presented on the television. Meltzoff, however, found no difference in the imitation performance of 14-month-olds following either a live (1985) or video (1988a) demonstration, even though the infants in the video condition were tested with an object that was at least 10 times larger than the televised image of that object the day before. Furthermore, Barnat et al. (1996) have also shown that infants as young as 14 months exhibit deferred imitation following live demonstrations, even when they are tested with stimuli that differ in size relative to those present during the original demonstration.

Finally, it is possible that infants and young children may have difficulty in learning from television because their attention is not as focused when they are looking at a video demonstration as when they are looking at a live demonstration of the same task. In Experiment 2 of the present study, however, there was no difference in the percentage of looking time in the video and live demonstration conditions. Furthermore, infants exhibited other evidence of active involvement during the video demonstration, such as vocalization.

In addition to the perceptual and attentional explanations described above, a number of cognitive explanations have been offered to account for children's difficulty in learning from television. Troseth and DeLoache (1998) have argued that children's immature understanding of the representational nature of television makes it difficult for them to use a televised image as a symbol for current reality. That is, infants and young children may not understand that an image on the television can represent or "stand for" something else (for a similar argument regarding pictures and models, see DeLoache, 1991, 1995; DeLoache & Burns, 1994). In fact, there may be a substantial trade-off between television as a source of entertainment and television as a source of information. Given that most children have not had the opportunity to interact with the objects or people they have seen on television, the symbolic potential of television may be undermined by the child's prior experience (Troseth & DeLoache, 1998).

Schmitt (1997) has provided an additional cognitive explanation for children's difficulty in learning tasks from television. She has hypothesized that when the representation of the televised information is established, it may be weaker than a similar representation based on live information. In her experiment on object hiding, for example, Schmitt found that the performance of the 2-year-olds in the live condition increased over successive trials, but that the performance of the 2-year-olds in the television condition actually declined over trials. Based on these data, Schmitt argued that a representation based on the televised information is weaker and is more susceptible to disruption across successive trials than a representation based on live information. The data from the present study provide some support for Schmitt's hypothesis. If we compare the imitation performance of the 15-month-olds in Experiments 2 and 3 who were tested with the rattle stimuli, for example, infants in the live condition show no forgetting after 24 hours (immediate score = 1.67; 24-hour score = 2.00), whereas infants in the video condition show evidence of forgetting over the same delay (immediate score = 1.25, 24-hour score = .66).

Taken together, the present findings and those of Troseth and DeLoache (1998) and Schmitt (1997) underscore the importance of a developmental perspective to our understanding of children's ability to learn from television. Conclusions based on a single task may be misleading regarding the age at which infants and young children are first able to acquire and use information gleaned from television (cf. Rudy et al., 1984). For a given task, there may be a considerable lag between the age at which infants and young children can first master the task, and the age at which they can use information from television to complete the same task. The ability to learn from television is undoubtedly constrained by both perceptual factors unique to television and by general cognitive development as well. The relative contribution of each of these factors needs to be incorporated into any comprehensive theory of children's television viewing.

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REFERENCES

Anderson, D., & Levin, S. R. (1976). Young children's attention to "Sesame Street." *Child Development, 47*, 806–811.

Anderson, D., Lorch, E. P., Field, D. E., Collins, P. A., & Nathan, J. G. (1986). Television viewing at home: Age trends, visual attention, and time with TV. *Child Development, 57*, 1024–1033.

Anderson, D., Lorch, E. P., Field, D. E., & Sanders, J. (1981). The effects of TV program comprehensibility on preschool children's visual attention. *Child Development, 52*, 151–157.

Ball, S., & Bogatz, G. A. (1970). *The first year of Sesame Street: An evaluation.* Princeton, NJ: Education Testing Service.

Bandura, A. (1965). Influence of models' reinforcement contingencies on the acquisition of imitative responses. *Journal of Personality and Social Psychology, 1*, 589–595.

Bandura, A., Ross, D., & Ross, S. A. (1963). Imitation of film-mediated aggressive models. *Journal of Abnormal and Social Psychology, 66*, 3–11.

Barnat, S., Klein, P., & Meltzoff, A. N. (1996). Deferred imitation across changes in context and object: Memory and generalization. *Infant Behavior and Development, 19*, 241–252.

Barney, W. D. (1973). TV viewing habits of 3, 4, and 5 year old children. *New Zealand Psychologist, 2*, 15–27.

Barr, R., Dowden, A., & Hayne, H. (1996). Developmental changes in deferred imitation by 6- to 24-month-old infants. *Infant Behavior and Development, 19*, 159–170.

Barr, R., & Hayne, H. (in press). Age-related changes in imitation: Implications for memory development. *Progress in Infancy Research*, (Vol. 1). Mahwah, NJ: Erlbaum.

Bauer, P. J., Hertsgaard, L. A., & Wewerka, S. S. (1995). Effects of experience on long-term recall in infancy: Remembering not to forget. *Journal of Experimental Child Psychology, 59*, 260–298.

Bauer, P. J., & Shore, C. M. (1987). Making a memorable event: Effects of familiarity and organization on young children's recall of action sequences. *Cognitive Development, 2*, 327–338.

Bogatz, G. A., & Ball, S. (1971). *The second year of Sesame Street: A continuing evaluation* (2 vols.). Princeton, NJ: Education Testing Service.

DeLoache, J. S. (1991). Symbolic functioning in very young children: Understanding of pictures and models. *Child Development, 62*, 736–752.

DeLoache, J. S. (1995). Early understanding and use of symbols: The model model. *Current Directions in Psychological Science, 4*, 109–113.

DeLoache, J. S., & Burns, N. M. (1994). Early understanding of the representational function of pictures. *Cognition, 52*, 83–110.

Greenfield, P. M. (1984). *Mind and media: The effects of television, computers and video games.* Cambridge, MA: Harvard University Press.

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., MacDonald, S., & Barr, R. (1997). Developmental changes in the specificity of memory over the second year of life. *Infant Behavior and Development, 20*, 237–249.

Hollenbeck, A. R., & Slaby, R. G. (1979). Infant visual and vocal responses to television. *Child Development, 50*, 41–45.

Huston, A. C., Watkins, B. A., & Kunkel, D. (1989). Public policy on children's television. *American Psychologist, 44*, 424–433.

Huston, A. C., & Wright, J. C. (1983). Children's processing of television: The informative function of formal features. In J. Bryant & D. R. Anderson (Eds.), *Children's understanding of television* (pp. 35–68). New York: Academic Press.

Jaglom, L. M., & Gardner, H. (1981). The preschool television viewer as anthropologist. In H. Kelly & H. Gardner (Eds.), *Viewing children through television* (pp. 9–30). San Fransisco: Jossey-Bass.

Lemish, D. (1987). Viewers in diapers: The early development of television viewing. In T. R. Lindlof (Ed.), *Natural audiences: Qualitative research of media uses and its effects* (pp. 33–57). Norwood, NJ: Ablex.

McCall, R. B., Parke, R. D., & Kavanaugh, R. D. (1977). Imitation of live and televised models by children one to three years of age. *Monographs of the Society for Research on Child Development, 42*(5, Serial No. 173).

Masur, E., & Ritz, E. G. (1984). Patterns of gestural, vocal, and verbal imitation in infancy. *Merrill-Palmer Quarterly, 29*, 69–82.

Meltzoff, A. N. (1985). Immediate and deferred imitation in fourteen- and twenty-four month-old infants. *Child Development, 56*, 62–72.

Meltzoff, A. N. (1988a). Imitation of televised models by infants. *Child Development, 59*, 1221–1229.

Meltzoff, A. N. (1988b). Infant imitation and memory: Nine-month-olds in immediate and deferred tests. *Child Development, 59*, 217–225.

Meltzoff, A. N. (1995). What infant memory tells us about infantile amnesia: Long-term recall and deferred imitation. *Journal of Experimental Child Psychology, 59*, 497–515.

Nielsen Media Research. (1997, April). *Nielson report on television.* New York: Author.

Piaget, J. (1962). *Play, dreams and imitation in children.* New York: Norton.

Rice, M., & Haight, P. L. (1986). "Motherese" of Mr. Rogers: A description of the dialogue of educational television programs. *Journal of Speech and Hearing Disorders, 51*, 282–287.

Rice, M. L., Huston, A. C., Truglio, R., & Wright, J. (1990). Words from "Sesame Street": Learning vocabulary while viewing. *Developmental Psychology, 26*, 421–428.

Rudy, J. W., Vogt, M. B., & Hyson, R. L. (1984). A developmental analysis of the rat's learned reactions to gustatory and auditory stimulation. In R. E. Kail & N. E. Spear (Eds.), *Comparative perspectives on memory development* (pp. 181–208). Hillsdale, NJ: Erlbaum.

Schmitt, K. (1997). *Two- to three-year-olds' understanding of the correspondence between television and reality.* Unpublished doctoral dissertation, University of Massachusetts, Amherst.

Siegel, S., & Castellan, N. J. (1988). *Nonparametric statistics for the behavioral sciences.* New York: McGraw-Hill.

Stein, A., & Friederich, L. (1975). Impact of television on children and youth. In E. M. Hetherington (Ed.), *Review of child development research* (Vol. 5, pp. 183–256). Chicago: University of Chicago Press.

Troseth, G. L., & DeLoache, J. S. (1998). The medium can obscure the message: Young children's understanding of video. *Child Development, 69*, 950–965.

Uzgiris, I. C., & Hunt, J. M. (1975). *Assessment in infancy.* Chicago: University of Chicago Press.