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Imitation of Televised Models by Infants

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Abstract

Studies indicate that infants in our culture are exposed to significant amounts of TV, often as a baby-sitting strategy by busy caretakers. The question arises whether TV viewing merely presents infants with a salient collection of moving patterns or whether they will readily pick up information depicted in this 2-D representation and incorporate it into their own behavior. Can infants "understand" the content of television enough to govern their real-world behavior accordingly? One way to explore this question is to present a model via television for infants to imitate. Infants' ability to imitate TV models was explored at 2 ages, 14 and 24 months, under conditions of immediate and deferred imitation. In deferred imitation, infants were exposed to a TV depiction of an adult manipulating a novel toy in a particular way but were not presented with the real toy until the next day. The results showed significant imitation at both ages, and furthermore showed that even the youngest group imitated after the 24-hour delay. The finding of deferred imitation of TV models has social and policy implications, because it suggests that TV viewing in the home could potentially affect infant behavior and development more than heretofore contemplated. The results also add to a growing body of literature on prelinguistic representational capacities. They do so in the dual sense of showing that infants can relate 2-D representations to their own actions on real objects in 3-D space, and moreover that the information picked up through TV can be internally represented over lengthy delays before it is used to guide the real-world action.

There is an increasing interest in the experimental study of imitation in infancy, with heightened attention to the possibility that imitative processes may play a role in the early development of speech (Kuhl & Meltzoff, 1988), language (Snow, 1981; Speidel & Nelson, in press), and early motor, cognitive, and social skills (Meltzoff, 1985, 1988a, 1988b, 1988c; Uzgiris, 1981). As imitation is elevated to a more prominent role in early learning and development, a question arises about the possible impact of TV on infants, because research has shown that television is a prominent part of the natural ecology of modern-day infants.

Of today's American homes, 99% have at least one television set (Singer & Singer, 1981). Much has been made about the viewing appetite of adults (Comstock, Chaffee, Katzman, McCombs, & Roberts, 1978), but the data also indicate that television viewing begins quite early. According to a recent Nielsen report (1987), the average 2–5-year-old views about 28 hours per week of television, a figure compatible with a previous study showing that preschoolers spend over one-third of their waking hours viewing TV (Friedrich & Stein, 1973). There is evidence for purposive, selective, and systematic viewing in children between 2 and 3 years of age (Anderson, Alwitt, Lorch, & Levin, 1979; Anderson & Lorch, 1983), and it has been shown that by 3 years three-quarters of the children can name their favorite TV program (Lyle & Hoffman, 1972).

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Although little work has been done concerning the amount of TV viewing by children under 2 years of age, one study found that they were exposed to an average of about 2 hours of television a day (Hollenbeck, 1978; see also Anderson, Lorch, Field, Collins, & Nathan, 1986). Systematic home observations of infants reveal that TV viewing is interspersed throughout the infant's day, including during eating, diaper changing, and other ordinary routines (Lemish & Rice, 1986). Perhaps the most striking evidence for the impact of TV on infants comes from work concerning TV exposure and early language. In the Lemish and Rice (1986) study, a 23-month-old watching a commercial was observed to repeat: "Coke is it, Coke is it, Coke is it." Another 23.5-month-old, whose father was sitting with a bottle of beer, pointed to the bottle and exclaimed: "Diet Pepsi, one less calorie."

While this suggests that material from the audio track of TV may be directly incorporated into infants' repertoires, it does not show that the visual images have a similar effect. Perceptually there is little or no difference between "real" and "TV" speech (subject only to the fidelity of the TV speaker), but this is not the case with the visual channel. Television presents a two-dimensional depiction of actions in three-dimensional space, and questions may be asked about infants' tendency to duplicate a 2-D representation of reality. Can infants relate the activities they see on television to their own behavior? There has been little research on infants' imitation of televised action patterns, the only experiments having been done on 1.5–3-year-old children (McCall, Parke, & Kavanaugh, 1977). One aim of this study is to test imitation of televised actions by prelinguistic infants. Another goal is to assess the possible long-term effect of TV viewing on infants' behavior.

As pointed out in the social-learning literature (Bandura, 1977), a necessary prerequisite for TV playing a substantive role in everyday life is that subjects not only be affected during the TV depiction itself but also have the ability to observe an action on TV at one point in time and then direct their behavior accordingly at a significantly later time. This type of phenomenon is termed "deferred imitation" in the developmental literature, and it has been investigated under two different procedures when using live models. (1) Infants have been exposed to a display and been allowed to imitate on-line; they have then been tested later to see if they will repeat this imitation at a later point in time (McCall et al., 1977). (2) Infants have been confined solely to observation of the display and no action at Time 1; then a delay interval has been inserted and they have then been tested to see if they will imitate for the very first time after this delay (McCall et al., 1977, experiment 3; Meltzoff, 1985, 1988a, 1988b). Although successful imitation has been reported using both procedures, the latter task is widely agreed to be the more cognitively demanding of the two (Flavell, 1985; Meltzoff, 1988a; Piaget, 1962) and within the context of TV studies it would most closely approximate normal viewing conditions. When children see an adult manipulate an object on TV, they may not have immediate access to the object What is hoped by television advertisers and designers of educational programs alike is that the viewer can absorb the information upon first viewing and then apply it appropriately when the opportunity presents itself at a significantly later time. The present study evaluated infants' ability to perform deferred imitation using the second type of procedure described above—one in which no immediate imitation of the model is allowed before the delay is inserted.

Reported here is a laboratory experiment of the imitation of televised models at two different ages, 24 and 14 months. Infants were presented with a TV representation of an adult performing a simple action on a novel toy and tested to see if they would imitate that act when subsequently presented with the "real" three-dimensional toy to manipulate. Infants were tested immediately and in a deferred-imitation procedure using a 24-hour delay.

Method

Subjects

The subjects were recruited by telephone calls to parents based on birth announcements in the local newspaper. Criteria for admission into the study were that the children be healthy, with no known physical or mental handicaps, and that they be of normal birth weight (2,500–4,500 grams) and gestational age (greater than or equal to 37 weeks gestation by maternal report).

Three groups of infants served as subjects. Each group consisted of 40 subjects and included equal numbers of males and females. The groups were tested consecutively, but for ease of exposition are reported as one large-scale study. The subjects in Group 1 were 2 years old at the time of test (*M* = 2 years, 6.78 days; SD = 4.00 days). The subjects in Group 2 were 14 months old (*M* = 61.14 weeks; SD = 4.14 days), and the subjects in Group 3 were also 14 months old (*M* = 61.33 weeks; SD = 6.09 days). In addition to the 120 subjects who completed the study, others were tested but dropped from the study for the following reasons: six for refusal to sit at the test table, or touch the toy, or look away from the parent; two due to equipment failure; and 20 due to parental procedural error. The latter group consisted chiefly of parents showing or telling subjects what to do as they presented them with the 3-D test object. (Other than through prior instruction, which was used, the experimenter could not regulate parental behavior on-line, because he was present only as a TV image.)

Stimulus—The object used in this test was not a commercially available toy with which the children may have had previous experience, but a novel toy fashioned from materials around the laboratory. It was a dumbbell-shaped object 12.5 cm in length. The object could be pulled apart and put back together again, an action that previous work with the same object (Meltzoff, 1985) showed was of great interest to children of this age. The object consisted of two unpainted wooden cubes (2.5 × 2.5 cm), which were connected by short lengths of hollow tubing (7.5 cm). The tubing extending from one cube was slightly narrower (0.95 cm) than that from the other (1.3 cm), so that the two halves of the object fit snugly together. The two halves fit firmly enough that they did not simply fall apart when the toy was picked up and handled or was banged on the table.

Test environment and apparatus—The test took place in a laboratory suite consisting of two adjoining rooms that were unfurnished except for the test equipment. The infant and parent sat in the test room and the experimenter in the control room.

Each infant was seated on his or her parent's lap in front of a small table. Directly across the table was a black-and-white TV monitor (Setchell Carlson 22-inch monitor), which was used to present the model. The TV screen was situated at approximately eye level and at a distance of 1.2 m from the subject. When the experimenter appeared on the screen, he was shown from about 2.5 cm above his head to just above his waist, much as a television newscaster might appear. The resulting picture was a reduction of approximately 40% from life size. Slightly to the right of the television was a video camera that recorded the infants' reactions.

In the adjoining control room the experimenter sat in front of a video camera situated at about eye level. The signal from this camera was fed to the TV monitor viewed by the infant. Directly below the camera was a small monitor that displayed the infant's behavior to the experimenter. The experiment was electronically timed by a character generator that mixed the elapsed time in 0.10-sec increments onto the videotape record.

Procedure—Upon arriving at the university, the families were escorted by an assistant to a waiting room located close to the test suite. Infants were allowed to acclimate for approximately 10 min while their parents completed consent forms and had the experiment explained to them. Parent and infant were then escorted to the test room and positioned at the table facing the television set. Next, in the control room the male experimenter walked into the camera's field of view and sat down in front of it. He thus was seen to emerge from "off camera" and to appear on the infant's TV. The parent had previously been instructed to point to the TV and to say, "Oh look at that" as the experimenter appeared on screen, and the experimenter returned this greeting, saying, "Can you see me? Now I want to show the baby something I hope will be interesting." If the subject did not immediately look at the TV when the experimenter appeared, which was rare, the parent and experimenter directed the infant's attention to it—the parent by pointing to the TV and repeating "Look," and the experimenter by repeating "Can you see me?" or "Look over here." Most often the infant was visually attracted to the movement on the TV and little other prompting was needed. In any case, no language associated with the task at hand was permitted; thus words like "copy," "duplicate," "imitate," and so forth were excluded, while visual attention words like "look" and "see" were permitted to ensure that the infant was at least fixating the TV when the target action was demonstrated.

Within each group of 40, infants were randomly assigned to either the imitation ($n = 20$) or control conditions ($n = 20$), with the restriction that each was composed of an equal number of males and females. Because the procedure for testing immediate imitation was identical for both age groups (Groups 1 and 2), this is described first. In the imitation condition, the experimenter brought the test object up from his lap (thus it first appeared at the lower edge of the TV) and held it at mid-chest height Once the infant fixated the toy, the experimenter pulled it apart with a very definite movement. He then reassembled it and repeated the action two more times. The duration of this stimulus-presentation period was 20 sec. At the end of this period the experimenter lowered the toy to his lap, and thus it moved off camera at the bottom edge of the TV screen. For all infants, whether in the experimental or control conditions, the experimenter wore the same solid blue sweater to provide a homogeneous background for his target action.

The parent had been previously instructed that at the end of the TV presentation she was to pick up an identical toy, which was hidden next to her seat, and place it on a spot on the table directly in front of the infant. If the parent did not do so immediately the experimenter verbally reminded her to "place the object on the table." A 20-sec response period was initiated from the time the infant first touched the toy. During the response period neither the mother nor the experimenter said anything, regardless of the infant's response.

Two control conditions were used, both treated similarly to the imitation condition but with the key exception that neither were shown the target act. One of the controls, the "baseline," was used to assess infants' spontaneous propensity to produce the target action on their own. Infants in this condition were exposed to the experimenter on TV but were not shown the toy or the target action. After the experimenter appeared on TV, the parent simply placed the toy on the table in front of the infant and a 20-sec response period was initiated as before. A second group provided an additional control by more closely mimicking aspects of the modeling condition. In this "adult-manipulation" control, the infants saw the TV experimenter pick up the object and manipulate it without displaying the specific target action under test. For this condition the experimenter moved the toy in a circle, then briefly paused and repeated this two more times. The diameter of the circle was approximately equal to the linear extent of the pull-apart act (42 cm). The timing of the three actions was the same as the three in the imitation test condition, and the overall duration of the stimulus-presentation period was also the same (20 sec). After the toy was lowered off the TV screen, the parent then placed the three-dimensional object on the table surface, and the 20-sec response period was initiated as before. This control was used to guard against the possibility that infants in the imitation condition might simply be induced to manipulate the object after seeing the TV model pick it up and draw their attention to it, whereas infants in the baseline condition would not be so stimulated. In such a case, finding a difference in infants' behavior in a baseline versus imitation comparison might reveal some level of object recognition between the 2-D depiction and the real 3-D object (which would be of interest), but it would not necessitate the interpretation of the true imitation of televised acts. The inclusion of the adult-manipulation control helps address this point because in this control the same televised adult picked up the same object and manipulated it for the same length of time as in the imitation condition. He simply did not demonstrate the target action.

Although previous work using these two controls, baseline and adult manipulation, revealed no differential tendency for infants to produce the target behavior (Meltzoff, 1985, 1988b), it seemed worthwhile to include both because taken together they provide a rigorous assessment of infants' tendency to produce the target behavior for spontaneous, nonimitative reasons. Using this procedure, differentially more of the target behavior in the imitation versus control groups permits the inference of imitation of televised behavior.

The same basic procedure and same three test conditions were also used in the test of infants' deferred reactions (Group 3). The principal difference was that a 24-hour delay (range = 24–24.5 hours) was imposed between the initial TV modeling and the presentation of the real, 3-D toy. For infants in the imitation condition, the experimenter emerged from left of the TV (identically as in the immediate tests), sat down, and then showed the infants the pulling movement. The infants were then sent home until the next day. In the adult-manipulation control, the experimenter likewise appeared on TV, demonstrated the circle movement, and then sent the infants home. In the baseline condition, the experimenter appeared on TV and then, without showing the infant the toy, simply sent the infants home. The session on day 2 was identical for all three test conditions. The experimenter appeared on TV and instructed the parent to pick up the 3-D toy hidden next to her or him and place it on the table directly in front of the infant. The 20-sec infant response period was timed exactly as in the immediate tests. Infants were not permitted to see the live experimenter at any time before or during the test on either day 1 or 2, and in this sense the procedure mimicked home TV viewing in which a television character would, of course, never have been seen "live."

Scoring—The videotapes of the 20-sec response periods contained no record as to the infants' experimental conditions. The 120 response periods, one for each infant, were scored in a random order by a coder who remained uninformed about the subjects' test conditions. The coder used paper and pencil to record a yes/no judgment as to whether or not the infant pulled the toy apart. The toy was scored as having been pulled apart when the two halves were visibly separated. Intra- and interobserver agreement were assessed by having a randomly selected 25% of the data scored twice by one observer and once by a second observer. There was 100% agreement on both the intra- and interobserver assessments.

Results

The results show that infants who see the target act modeled on TV are more likely to produce that act when subsequently given access to the 3-D toy than are infants in the controls. Table 1 presents the raw data matrix of the number of infants producing the target act as a function of test condition (baseline, adult manipulation, imitation) and group (24-month immediate, 14-month immediate, 14-month deferred). These data were analyzed both parametrically and nonparametrically, with highly consistent results. A 3 (test condition) × 3 (group) ANOVA revealed a main effect for test condition, $F(2,111) = 16.90$, $p < .001$, with more infants producing the target act in the imitation condition (65%) than in the baseline control (20%) or adult-manipulation control (20%). There was also a main effect for group, $F(2,111) = 5.43$, $p < .01$. The test condition × group interaction was not significant, $F(4,111) = 1.88$. An alternative to the ANOVA approach that was designed to handle zero/one data is the logistic regression method (Weisberg, 1985). The data were also reanalyzed using this method, and the results again showed a significant test condition effect ($p < .0001$), a significant group effect ($p < .01$), and no significant test condition × group interaction. These results show more target production in the imitation than control conditions and also that this effect of imitation does not significantly vary as a function of group. However, as might be expected from previous work using live models (Meltzoff, 1985), there is a difference in the general amount of toy pulling (considering both the imitation and control conditions) as a function of group; the 14-month-olds after the delay have a generally lower probability of producing the target in both the imitation and control conditions. This replicates the identical pattern when live models were used (Meltzoff, 1985) and may reflect both: (*a*) a greater manual dexterity in the 24-month-old group, and hence more overall toy pulling in the older than younger group; and (*b*) the social dynamics of reunion with the stranger (heightened curiosity and interaction with him over the toy) in comparing the two-visit deferred to the one-visit immediate groups. (For a further discussion of this point see Meltzoff, 1985.) This underlines the need to compare the reactions of infants in the imitation condition to controls well matched on all dimensions but for exposure to the target action.

This same general picture was obtained by nonparametric analyses using a series of 2 × 2 contingency tables contrasting the number of infants who did or did not produce the target as a function of imitation or control conditions. Given the a priori prediction that more infants should produce the target after seeing it modeled than in the controls, one-tailed chi-square tests were used. Combining all three groups, the overall chi-square was highly significant, $\chi^2(l, N = 120) = 23.05$, $p < .001$, with more infants producing the target in the imitation condition than in the controls. Isolating Group 1 (24-month immediate), the results also showed a significant effect of imitation, $\chi^2(1, N = 40) = 17.07$, $p < .001$, with 90% of the imitation subjects producing the target as opposed to 20% of the controls. Isolating Group 2 (14-month immediate), the results showed a significant effect of imitation, $\chi^2(1, N = 40) = 3.61$, $p < .05$, with 65% of the imitation subjects producing the target as opposed to 30% of the controls. Finally, isolating Group 3 (14-month deferred), the results also showed a significant effect of imitation, $\chi^2(1, N = 40) = 3.33$, $p < .05$, with 40% of the imitation subjects producing the target as opposed to 10% of the controls. A chi-square test for homogeneity was used to compare these three 2 × 2 tables and assess whether the imitation effect significantly differed as a function of group (Fleiss, 1981). The results showed that the imitation effect (more target production in the imitation vs. control conditions) did not significantly vary as a function of group, $\chi^2(2, N = 120) = 3.54$, $p > .15$, which is in line with the parametric analyses showing no condition × group interaction.

Discussion

These results have implications for four areas, which will be considered in turn below: infant imitation, social development, perceptual theory, and cognitive and representational growth. The results add to the growing body of literature on infant imitation in four ways. (1) They show that infants as young as 14 months of age will duplicate acts depicted on TV, even when they are presented by a stranger using an unfamiliar object, as they might be in home TV viewing. (2) The immediate imitation design used here demanded more than simple on-line imitation. The “real” object was not in the infant’s perceptual field during the televised display, and thus the infant did not have the opportunity of looking back and forth between the TV depiction and the real object. (3) The results of the deferred imitation group go one step further and establish that 14-month-old infants can remember an act depicted on TV over a 24-hour delay and can use that information to direct their motor behavior when they have access to the “real” 3-D object at this later time. (4) The findings open the possibility of greater stimulus control in studies of infant imitation. In lieu of live performances, TV displays may be useful not only for the obvious methodological reasons but also because such presentations may allow one to isolate particular features of the target act through computer synthesis in a manner precluded if one is restricted to using only real objects or actors.

The current findings also have implications for studying social development and the natural ecology of infancy. The use of TV could potentially enhance experimental investigations of social learning between infants and their peers and siblings. Such experiments are complex (Bronson, 1981; Eckerman, Whatley, & Kutz, 1975), in part because the peers do not always adhere to the planned experimental manipulations, and computer-controlled TV peers may be useful in this regard. On the other hand, it is clear that the sounds and sights of TV are very much a part of the infant-toddler natural ecology in modern culture; Steiner (1963) found that about one-third of parents rated “baby sitting” as one of the main advantages of TV, a point also highlighted in the more recent home observations by Lemish and Rice (1986). It is sobering to realize that, at least under the laboratory conditions described here, infants early in the second year of life can incorporate and repeat behaviors they see presented on TV. It may be injudicious to assume that TV viewing will leave the infant unaffected, especially in light of recent findings about such influences in early childhood (Rice, Huston, & Wright, 1982; Singer & Singer, 1981; Williams, 1986).

The current findings also bear on issues in perceptual theory. Gombrich (1960), Goodman (1968), and others have emphasized the arbitrary, conventional, and symbolic relation between a picture, photograph, or film and the three-dimensional world. Previous work on early picture recognition (DeLoache, Strauss, & Maynard, 1979; Dirks & Gibson, 1977; Hochberg & Brooks, 1962; Rose, 1977) seems to refute the strong version of these theories (see also Gibson, 1979); nonetheless, there are different levels at which one might address whether or not a two-dimensional representation is perceived and understood to stand for a three-dimensional scene (Bower, 1972, 1977).

The previous work on picture perception using habituation or paired-comparison techniques shows that infants under 6 months can recognize some similarities between a 2-D and a 3-D display. These may be very simple distinctive features such as color, the overall silhouette or outline of a figure, or the general complexity of the display. More recent work on intermodal perception, using similar paradigms, shows that infants can relate particular speech sounds to films of the matching articulatory movements (Kuhl & Meltzoff, 1982, 1984, 1988) and can also relate emotionally toned vocalizations to films of emotional expressions (Walker, 1982). These and other examples of intermodal perception involving 2-D displays (e.g., Bahrick, 1983; Spelke, 1979) all show just that—recognition. They do not conclusively demonstrate that infants can use a 2-D visual depiction to guide their actions on the 3-D world. In order to address this latter question, investigators have explored the circumstances under which infants will initiate meaningful action based on 2-D depictions. For example, Bower, Broughton, and Moore (1970) reported that infants avoided optical expansion patterns as if they were real objects about to collide with them, and Yonas and his colleagues (Granrud et al., 1984; Yonas, Cleaves, Pettersen, 1978) reported appropriate reaching to the apparently nearer region of a 2-D surface. An important point in these studies, however, is that the displays were designed to act as “surrogates” for the 3-D array, in the sense that conflicting cues and the salience of the stimulus as a two-dimensional entity were minimized. Thus Yonas often used monocular viewing conditions and exercised careful psychophysical control over illumination and visual cues enhancing apparent tangibility.

These studies do not address the intriguing fact that adult viewers treat 2-D displays simultaneously in a dual capacity: they are clearly seen as 2-D and therefore not "real" in any sense, and yet at the same time as "representations" standing for 3-D scenes and providing information to guide our real actions in 3-D space. For example, a map shows us where to dig for treasure (it represents someplace in real space, not on the paper surface itself), and violent acts on TV lead to closely matched copycat crimes in the real world displaced in time and space from the 2-D depiction of them (Bandura, 1973).

The current study was designed with this perspective in mind. The TV set was deliberately left as a freestanding box so that the experimenter's body was cut off at mid-stomach; it was a black-and-white picture, with the result that skin and hair tones were unnatural; the picture was not life size, but presented a miniaturized person; the room lights were left on, and thus there were reflections on the TV screen specifying it as a flat surface; and so on. In short, the televised model was not arranged to be a sensory surrogate but rather a 2-D representation of the 3-D world. The results show that infants as young as 14 months old can use this type of information to guide their real-world actions. As such the results complement and extend the previous research on the infant's perception, understanding, and use of 2-D displays.

Finally, the results bear on certain debates in cognitive development that are related to the above perceptual points. The notion of "representation" has been used in at least two senses in the cognitive-developmental literature. On the one hand, theorists have discussed the ontogeny of infants' ability to store and subsequently act on internal representations of absent objects and events—as measured by manual search for invisibly displaced objects (object permanence), deferred imitation, and other so-called Stage 6 phenomena (Meltzoff, 1988c; Piaget, 1952, 1962). On the other hand, representation has also been discussed in the sense of "X standing for Y" (Bruner, Olver, & Greenfield, 1966; Werner & Kaplan, 1963). The finding of deferred imitation from TV displays is of interest because it simultaneously taps both aspects.

The deferred study was designed such that infants could not imitate immediately. They were confined merely to observation during the display and did not simultaneously have access to the test object. The delay was significantly lengthy to ensure that no sort of temporary "motor set" could operate. This design fulfills Piaget's criteria for deferred imitation, and the results suggest that representation in the first sense may occur somewhat earlier than the classically cited age of 18–24 months, during sensorimotor Stage 6 (Flavell, 1985; McCall et al., 1977; Piaget, 1962; Smolak, 1986). The effects are compatible with other reports of deferred imitation over lengthy delays in infants this same age or younger (Meltzoff, 1985, 1988a, 1988b); however, these previous findings all used live models. In this latter case infants were directly mimicking with their own bodies acts that were seen in 3-D space, with a minimum of differences between the stimulus (the adult's actions) and the response (the imitative act). The current findings are the first to show that infants younger than the 18–24-month age period can perform deferred imitation when there is some "distancing" (Werner & Kaplan, 1963) between the stimulus and response, that is, when the initial display to be stored is not in the identical format as the subsequent matching response. It would now seem profitable to investigate whether infants this age could imitate if there were still further distancing, for example, if the information were depicted by 3-D dolls or other symbolic models such as a series of stick-figure drawings. Such studies would help elaborate the development of infants' understanding of representation in the second sense described above, which is of interest because of its hypothesized connection to the most flexible of all representations—language (Piaget, 1962; Werner & Kaplan, 1963).

Even without these additional data, the current results indicate that 14-month-old infants can readily use a two-dimensional depiction to guide their own three-dimensional behavior on the world. In this primitive sense, infants can “make sense of” the representational medium of television. These findings raise the possibility that exposure to TV in the home may potentially influence infant behavior more than heretofore contemplated.

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References

Anderson, DR.; Alwitt, LF.; Lorch, EP.; Levin, SR. Watching children watch television. In: Hale, GA.; Lewis, M., editors. Attention and cognitive development. New York: Plenum; 1979. p. 331-361.

Anderson, DR.; Lorch, EP. Looking at television: Action or reaction?. In: Bryant, J.; Anderson, DR., editors. Children’s understanding of television: Research on attention and comprehension. New York: Academic Press; 1983. p. 1-33.

Anderson DR, Lorch EP, Field DE, Collins PA, Nathan JG. Television viewing at home: Age trends in visual attention and time with TV. Child Development. 1986; 57:1024–1033. [PubMed: 3757598]

Bahrick LE. Infants’ perception of substance and temporal synchrony in multimodal events. Infant Behavior and Development. 1983; 6:429–451.

Bandura, A. Aggression: A social learning analysis. Englewood Cliffs, NJ: Prentice-Hall; 1973.

Bandura, A. Social learning theory. Englewood Cliffs, NJ: Prentice-Hall; 1977.

Bower TGR. Object perception in infants. Perception. 1972; 1:15–30. [PubMed: 4680922]

Bower, TGR. The perceptual world of the child. Cambridge, MA: Harvard University Press; 1977.

Bower TGR, Broughton JM, Moore MK. Infant responses to approaching objects: An indicator of response to distal variables. Perception and Psychophysics. 1970; 9:193–196.

Bronson, WC. Monographs on infancy. Norwood, NJ: Ablex; 1981. Toddlers’ behaviors with agemates: Issues of interaction, cognition, and affect.

Bruner, JS.; Olver, RR.; Greenfield, PM. Studies in cognitive growth. New York: Wiley; 1966.

Comstock, G.; Chaffee, S.; Katzman, N.; McCombs, M.; Roberts, D. Television and human behavior. New York: Columbia University Press; 1978.

DeLoache JS, Strauss MS, Maynard J. Picture perception in infancy. Infant Behavior and Development. 1979; 2:77–89.

Dirks J, Gibson E. Infants’ perception of similarity between live people and their photographs. Child Development. 1977; 48:124–130. [PubMed: 844350]

Eckerman CO, Whatley JL, Kutz SL. Growth of social play with peers during the second year of life. Developmental Psychology. 1975; 11:42–49.

Flavell, JH. Cognitive development. 2. Englewood Cliffs, NJ: Prentice-Hall; 1985.

Fleiss, JL. Statistical methods for rates and proportions. 2. New York: Wiley; 1981.

Friedrich LK, Stein AH. Aggressive and prosocial television programs and the natural behavior of preschool children. Monographs of the Society for Research in Child Development. 1973; 38(4) Serial No. 151.

Gibson, JJ. The ecological approach to visual perception. Boston: Houghton Mifflin; 1979.

Gombrich, EH. Art and illusion: A study in the psychology of pictorial representation. Princeton, NJ: Princeton University Press; 1960.

Goodman, N. Languages of art: An approach to a theory of symbols. New York: Bobbs-Merrill; 1968.

Granrud CE, Yonas A, Smith IM, Arterberry ME, Glicksman ML, Sorknes AC. Infants’ sensitivity to accretion and deletion of texture as information for depth at an edge. Child Development. 1984; 55:1630–1636. [PubMed: 6488967]

Hochberg J, Brooks V. Pictorial recognition as an unlearned ability: A study of one child’s performance. American Journal of Psychology. 1962; 75:624–628. [PubMed: 13963734]

Hollenbeck AR. Television viewing patterns of families with young infants. Journal of Social Psychology. 1978; 105:259–264.

Kuhl PK, Meltzoff AN. The bimodal perception of speech in infancy. Science. 1982; 218:1138–1141. [PubMed: 7146899]

Kuhl PK, Meltzoff AN. The inter-modal representation of speech in infants. Infant Behavior and Development. 1984; 7:361–381.

Kuhl, PK.; Meltzoff, AN. Speech as an intermodal object of perception. In: Yonas, A., editor. Perceptual development in infancy: Minnesota symposia on child psychology. Vol. 20. Hillsdale, NJ: Erlbaum; 1988. p. 235-266.

Lemish D, Rice ML. Television as a talking picture book: A prop for language acquisition. Journal of Child Language. 1986; 13:251–274. [PubMed: 3745331]

Lyle, J.; Hoffman, HR. Explorations in patterns of television viewing by preschool-age children. In: Rubinstein, EA.; Comstock, GA.; Murray, JP., editors. Television and social behavior (Vol. 4). Television in day-to-day life: Patterns of use. Washington, DC: Government Printing Office; 1972. p. 257-271.

McCall RB, Parke RD, Kavanaugh RD. Imitation of live and televised models by children one to three years of age. Monographs of the Society for Research in Child Development. 1977; 42(5) Serial No. 173.

Meltzoff AN. Immediate and deferred imitation in fourteen- and twenty-four-month-old infants. Child Development. 1985; 56:62–72.

Meltzoff AN. Infant imitation and memory: Nine-month-olds in immediate and deferred tests. Child Development. 1988a; 59:217–225. [PubMed: 3342714]

Meltzoff AN. Infant imitation after a 1-week delay: Long-term memory for novel acts and multiple stimuli. Developmental Psychology. 1988b; 24:470–476.

Meltzoff AN. Imitation, objects, tools, and the rudiments of language in human ontogeny. Human Evolution. 1988c; 3:47–66.

Nielsen, AC. Annual Nielsen report on television: 1987. New York: Nielsen Media Research; 1987.

Piaget, J. The origins of intelligence in children. New York: Norton; 1952.

Piaget, J. Play, dreams and imitation in childhood. New York: Norton; 1962.

Rice, ML.; Huston, AC.; Wright, JC. The forms of television: Effects on children's attention, comprehension, and social behavior. In: Pearl, D.; Bouthilet, L.; Lazar, J., editors. Television and behavior: Ten years of scientific progress and implications for the eighties. Washington, DC: Government Printing Office; 1982. p. 24-38.

Rose SA. Infants' transfer of response between two-dimensional and three-dimensional stimuli. Child Development. 1977; 48:1086–1091.

Singer, JL.; Singer, DG. Television, imagination, and aggression: A study of preschoolers. Hillsdale, NJ: Erlbaum; 1981.

Smolak, L. Infancy. Englewood Cliffs, NJ: Prentice-Hall; 1986.

Snow CE. The uses of imitation. Journal of Child Language. 1981; 8:205–212. [PubMed: 7204523]

Speidel, GE.; Nelson, KE. The many faces of imitation in language learning. New York: Springer-Verlag; in press

Spelke ES. Perceiving bimodally specified events in infancy. Developmental Psychology. 1979; 15:626–636.

Steiner, G. The people look at television. New York: Knopf; 1963.

Uzgiris IC. Two functions of imitation during infancy. International Journal of Behavioral Development. 1981; 4:1–12.

Walker AS. Intermodal perception of expressive behaviors by human infants. Journal of Experimental Child Psychology. 1982; 33:514–535. [PubMed: 7097157]

Weisberg, S. Applied linear regression. 2. New York: Wiley; 1985.

Wemer, H.; Kaplan, B. Symbol formation. New York: Wiley; 1963.

Williams, TM. The impact of television: A natural experiment in three communities. New York: Academic Press; 1986.

Yonas A, Cleaves WT, Pettersen L. Development of sensitivity to pictorial depth. Science. 1978; 200:77–79. [PubMed: 635576]

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TABLE 1

Number of Infants in Each of Three Groups Who Produced the Target Response as a Function of Test Condition

	Test Condition		
Group	**Baseline**	**Adult Manipulation**	**Imitation**
24-month immediate (*N* = 40):			
Yes..........................	3	1	18
No..........................	7	9	2
14-month immediate (*N* = 40):			
Yes..........................	2	4	13
No..........................	8	6	7
14-month deferred (*N* = 40):			
Yes..........................	1	1	8
No..........................	9	9	12
Combined (*N* = 120):			
Yes..........................	6	6	39
No..........................	24	24	21