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The Medium Can Obscure the Message: Young Children’s Understanding of Video

Georgene L. Troseth and Judy S. DeLoache

In the first few years of life, children acquire a great deal of general information through symbolic media, including television. Here we explore whether very young children would use information presented via video to solve a retrieval problem. The children watched on a monitor as a toy was hidden in the room next door. A group of 2½-year-olds was very successful at finding the hidden toy based on the televised hiding event, but a group of 2-year-olds was not. Substantially better performance was achieved by other 2-year-olds who either watched the hiding event directly through a window or who believed they were watching directly (but were in fact looking at the monitor through the window). These results (like those from other symbolic media such as models and pictures) indicate that very young children have difficulty using a symbolic representation as a source of information about an existing situation.

INTRODUCTION

Human experience is expanded and enriched by our capacity to invent and use symbols. Much of our knowledge is not gained through direct experience; rather, we frequently acquire information from the pictures, numbers, maps, graphs, and print in a variety of symbolic media. We may read the newspaper to find out about recent developments in politics, examine a magazine photo to see what a newly discovered dinosaur fossil looks like, or use an atlas to learn the present boundaries of the countries of Europe. In recent years, television has become an increasingly important source of information, enabling viewers to see places and events they have never experienced directly.

Video is pervasive not only in the lives of most adults in Western, industrialized societies, but also in the lives of very young children. The average American preschooler watches 2–3 hr of television and videotapes a day (Huston, Wright, Rice, Kerzman, & St. Peters, 1990; National Center for Education Statistics, 1992). In addition, a growing number of families make home videos, with the result that some young children have actually seen themselves on television. With all this exposure, what do young children understand about the relation of video images to reality?

Mature viewers are able to respond flexibly to video; they realize that some video images represent reality and could profitably be taken as a source of information, whereas others are the products of imagination, art, and acting. Children gradually learn to decipher the conventions or “formal features” of video that are used to symbolize temporal and spatial relations, including cinematic techniques such as cuts, zooms, and montage (Greenfield, 1984; Huston & Wright, 1983; Salomon, 1979; Smith, Anderson, & Fischer, 1985; Wright & Huston, 1981). For example, Wright, Huston, Reitz, and Piemyat (1994) reported that 5-year-olds use such cues to distinguish dramas from news and documentaries.

There are reasons to suspect, however, that very young children’s understanding of the relation between video and reality is far from complete. Anecdotal reports suggest that preschoolers may sometimes confuse video images and the objects and events they depict. Jaglom and Gardner (1981) describe an incident in which a 2-year-old went to get a paper towel after seeing an egg break on television. When a colleague’s 3-year-old daughter was informed that she was going to appear on television (in a PBS program highlighting research with young children), she responded hesitantly, “Will I still be here?” After becoming used to the idea, she enthused, “There’s going to be two of me!” Some young children have more enduring misconceptions about television, such as believing that little people and objects reside inside the set (Nikken & Peeters, 1988) or that television dramas provide glimpses of the ongoing lives of actual families (Hawkins, 1977).

In a series of experimental studies of young children’s understanding of pictures and video (Flavell, Flavell, Green, & Korfmacher, 1990), preschool children saw video images of objects, such as a bowl of popcorn. When the children were asked whether the popcorn would spill if the television set was turned upside down, a substantial number of 3-year-olds said it would. Some children also affirmed that a
glass of juice depicted in a photograph would spill if the photograph was inverted. Thus, the children appeared to be thinking about the referent of the image—a real bowl of popcorn or a real glass of juice—while answering, even though Flavell et al. made valiant attempts to get them to center their attention on the image itself. Preschool children had similar difficulty taking a picture itself—rather than its referent—as the topic of conversation in a study by Beilin and Pearlman (1991).

Although the children in these studies had difficulty talking about the video-reality distinction, research using nonverbal tasks has established that even very young children are able to learn from video. Meltzoff (1988) showed 14- and 24-month-olds a live video presentation of an adult manipulating a toy in a novel way. When the children were presented with the toy a day later, they imitated the actions they had seen earlier on video. The children’s success indicates that they not only made sense of the two-dimensional video image, but that they also mentally represented the televised events and applied that knowledge appropriately in the real world. McCall, Parke, and Kavanaugh (1977) also reported immediate and delayed imitation of televised adult models by 18- to 36-month-olds.

The experiments reported here employed a different approach, following a general paradigm that has been used to study early symbol understanding and use in a problem-solving context (e.g., DeLoache, 1995a). Specifically, we examined very young children’s use of information presented via video to solve a problem. Children watched a video monitor as an experimenter hid a toy in the room next door, and then they were asked to find the toy. Only if they use the televised event as a source of information about reality do they have any basis for retrieving the toy.

We thus ask young children to use a symbolic medium (a video event) to form a mental representation of an existing situation (the location of the toy in the room) and to use that representation to guide their behavior. The children have to use the event they observe on the screen as information about the location of an object in the real world. To succeed, they have to respond flexibly to this unusual use of a familiar medium. In contrast to the imitation studies, in which children learn how to do something with a novel object, the children in our research have to acquire information about current reality.

This retrieval task has previously been used to examine children’s use of other symbols, including pictures, maps, and scale models (DeLoache, 1987, 1991; DeLoache & Burns, 1994; DeLoache, Kolstad, & Anderson, 1991; Marzolf & DeLoache, 1994). In the model task, young children watch as a miniature toy is hidden in a model of a full-sized room, and they are asked to retrieve a similar but larger toy hidden in the corresponding place in the room itself. In the version using pictures, the experimenter indicates the location of the toy in the room by pointing on a photograph or a line drawing.

The results of these studies with pictures and models indicate that (1) appreciating symbol-referent relations can be surprisingly difficult, even when a symbol is highly similar to what it stands for, and (2) development occurs rapidly, although at different times for different kinds of symbols. In the middle-class American children tested, a clear developmental progression has been established: Three-year-olds are typically very successful in the model task, but 2½-year-olds typically perform very poorly. In the picture task, 2½-year-olds perform very well, but 2-year-olds rarely succeed.

This developmental progression has been attributed to two factors—dual representation and symbolic experience. The first factor is relevant to the large difference between 2½- and 3-year-olds in the model task, and the second to the equally dramatic difference between 2- and 2½-year-olds in the picture task. Young children’s difficulty in the scale model task has been interpreted as primarily due to the challenge of dual representation (DeLoache, 1987, 1991, 1995a; DeLoache, Miller, & Rosengren, 1997). According to the dual representation hypothesis, it is difficult for young children to represent and focus on the symbolic role of an object if their attention is captured by the object itself. The scale model used in the object-retrieval task is interesting and attractive in its own right, especially to young children. Being distracted by the model itself prevents young children from recognizing its relation to the room. A picture, in contrast, is not especially interesting as an object, so achieving dual representation is less of a challenge. As a consequence, 2½-year-olds are much more successful at using pictures than models (DeLoache, 1987, 1991).

The second factor presumed to contribute to the developmental progression described above is experience with symbols (DeLoache, 1995a; DeLoache & Burns, 1994). By 2 years of age, most American children have had substantial experience with pictures and picturebooks (Gelman, Coley, Rosengren, Hartman, & Pappas, in press), but they have probably never used a picture as a source of information about a currently existing reality. When asked to do so, as in the picture task, 2-year-olds behave as if the pictures have no relevance to the real-world situation. In contrast, 2½-year-olds flexibly use the pictures in this novel way to solve the retrieval problem. The
greater symbolic experience of the older children has presumably increased their general sensitivity to symbolic or "stands for" relations.

In the studies reported here, we examine 2- and 2½-year-old children’s use of video information. With respect to the older children, we made a firm prediction on the basis of dual representation: We expected that 2½-year-olds, who typically fail the scale model task, would be successful in a video task. As a two-dimensional medium, video should not require dual representation, so 2½-year-olds should be successful, just as they are with pictures. Experiment 1 presents evidence confirming the prediction.

With respect to the younger children, it was less clear what to expect. On the one hand, in several studies (DeLoache & Burns, 1994), 2-year-olds have consistently failed to find a toy after its location was pointed out on a photograph. Thus, it would be reasonable to expect 2-year-olds to perform equally poorly in a video retrieval task. Furthermore, slightly younger children have trouble selecting which one of three pictures depicts the outcome of a simple event (Harris, Kavanaugh, & Dowson, 1997). They apparently do not readily connect a picture with the real situation it represents.

On the other hand, a video presentation of a person hiding a toy contains more information than a still picture, because it shows the hiding event as well as the hiding place. Thus, one might expect that watching an event on video would be almost like watching it directly, so that even 2-year-olds would succeed at the video task. In support of the possibility that a video event might essentially be transparent to young children, several researchers have reported that primates are able to retrieve objects after seeing them hidden on video (Menzel, Premack, & Woodruff, 1978; Vauclair, 1996). Experiment 1 describes 2-year-old children’s retrieval of an object they had seen being hidden on video, Experiment 2 reports performance of the same age group for a directly observed hiding event, and Experiment 3 tests an interpretation of their performance in the first two studies.

EXPERIMENT 1

Method

Participants. Twenty-four children participated, including 12 (six boys and six girls) from each of two age groups: 2½-year-olds (29.0 to 32.5 months, \(M = 30.6\) months) and 2-year-olds (23.5 to 25.5 months, \(M = 24.5\) months). One additional participant (a 2½-year-old) failed to return for a second day of testing (described under Experiment 1A) and was eliminated. Half the children of each age and gender received one of two orders of hiding places. In all the studies reported here, names of potential participants were obtained through newspaper birth announcements, and parents were contacted by telephone. The children were predominantly European American and from middle-class homes.

Materials. Two adjoining rooms were used for all the experiments. The larger (6.51 × 5.49 × 2.55 m) was furnished like a living room. It was carpeted and contained two couches, a large armchair, a coffee table, an end table with drawers, a basket, a round table covered with a tablecloth, a pillow on one couch, a large plant, and a built-in set of bookcases and cupboards along one wall. The object that was hidden was a stuffed toy dog (15 cm high).

A videocamera on a tripod was connected to a color monitor (40 × 30 cm) so that images were projected "live" to the screen. The sound on the monitor was turned off. The monitor (on a rolling cart) was located in the large room during the orientation but was moved into the smaller control room for the retrieval trials. In the control room, the monitor was placed so that the depiction of the large room on the screen was in alignment with the real room (see Figure 1a). The videocamera, operated by an assistant, remained in the corner of the larger room throughout the session.

Procedure. The session lasted approximately 30 min. After becoming acquainted with the experimenter, children were given an extensive orientation designed to emphasize the correspondence between objects and events in the large room and those seen on the video monitor. First, the experimenter showed the children the toy dog (referred to as "Snoopy"), and then she pointed out and labeled the different pieces of furniture (some of which would serve as hiding places). Next, the experimenter drew attention to the videocamera (and operator) and the monitor. To get across the idea that what the children saw on the monitor was live, the experimenter asked them to identify themselves and their parents on the monitor and to point to their eyes and clothing "on TV." The toy and all items of furniture in the room were then shown on the monitor as the experimenter labeled them. The connection between the videocamera film each item and its presence on the monitor was explicitly and repeatedly pointed out ("Look, Pete's taking a picture of Snoopy's chair, and we can see it on TV").

In a further attempt to communicate the correspondence between events on the monitor and in the room, the child was asked to imitate a placement event after seeing it on video. He or she watched on
the monitor in the adjoining control room as an assistant walked into the large room and placed the toy on the coffee table. The experimenter narrated the action ("Look! Kathy's putting Snoopy right there!") pointing and calling the child's attention to the furniture item on the monitor (without labeling it). The assistant then removed the toy and brought it to the child, who was asked to put the toy in the same place. If the response was incorrect, the experimenter named the relevant place and helped the child put the toy there.

Following the orientation, there were four retrieval trials during which the children were required to find the toy in the room based on where they had seen it hidden on the monitor. On each trial, the toy was hidden in a different location (behind the chair, in the basket, under the couch pillow, and under the tablecloth on the round table). Before each trial, the experimenter announced that the assistant would now hide the toy and "we can watch her on TV." The child saw the assistant go out the door of the control room and then appear in the large room on the monitor. The assistant proceeded to hide the toy, using very deliberate motions and always making sure that the camera (and child) had a totally unobstructed view of the event. The experimenter remained with the child and drew his or her attention to the hiding event on the video screen, pointing and making comments such as, "Look, Kathy's hiding Snoopy right there." Then the assistant returned, and the child was asked to retrieve the toy. If the toy was not found on the first search, the experimenter encouraged the child to keep searching, providing increasingly explicit hints to ensure that the child successfully recovered the toy (only the first search was counted).

To succeed in this task, a child must use his or her mental representation of the hiding event observed via the video monitor to draw an inference about the location of the toy in the room. Successful searching thus indicates that a child appreciates the relation between the event seen on video and reality.

For all the studies reported here, parents completed a questionnaire about their children's exposure to video, including the amount of television and videotapes the child watched, whether the family used a videocamera, how often and how recently the child had been videotaped and/or watched a home video.

Results and Discussion

The dependent variable in all studies reported here was the number of errorless retrievals, that is, trials on which children found the toy in the first place they searched without any prompts. (Percentages are used in the figures and the text to facilitate comparison to other studies.) Figure 2 shows the level of errorless retrievals achieved by the two age groups on the video task. The performance of both groups was significantly above a chance level of 13% (chance was calculated based on the number of possible hiding places labeled in the orientation), but the younger children were less successful than the older children. The 2½-year-olds immediately retrieved the
toy on 79% of the trials. Having watched the hiding event on video, they knew where the toy was hidden in the room. Children just 6 months younger, however, usually searched in the wrong place (only 44% correct). This low rate of success occurred even though the younger children attentively watched the hiding events on the monitor.

The data were analyzed in a 2 (age) × 2 (gender) ANOVA. The only significant result was a main effect of age, $F(1, 20) = 9.70, p < .01$. Individual performance was also examined: nine of the 12 older children found the toy without error on three or four of the four trials, compared to only two of the 12 younger children ($p < .01$, Fisher’s Exact Test). There was no difference in performance across trials.

On the basis of dual representation (DeLoache, 1987, 1991, 1995a), we predicted that the performance of the 2½-year-old participants in the video task would be similar to that achieved by children of this age in previous picture studies (about 80%) and superior to the typical performance of their age group with models (<20%). The high success rate (79%) clearly confirms the predictions and therefore adds further support to the dual representation hypothesis.

We did not make a firm prediction for the 2-year-olds. Their average level of performance with video (44%) was somewhat higher than that achieved by children of the same age (6% to 27%) in previous picture studies (DeLoache & Burns, 1994). Given that video conveys added information (motion, depiction of the actual hiding event), this result does not seem surprising. At the same time, the video medium was not transparent to these young children in the way it seems to be for primates; only two of the 12 2-year-olds were highly successful at using information presented by video.

We examined the pattern of errors made by the children. As is typical in object retrieval studies, the most common kind of error at both ages was searching where the toy had been located on the previous trial (older, 60%; younger, 54%).

Data from the parent questionnaire are reported here for the children in Experiments 1–3. All the families owned VCRs, and 80% of the parents (or their close relatives) made home videos; the children, however, rarely saw these films. There was a wide range of how much television children were reported to watch. According to their parents, the 2½-year-olds from Experiment 1 ($N = 12$) watched between 2.0 and 23.5 hr of television and videotapes per week ($M = 12.6, SD = 6.8$). The 2-year-olds from Experiments 1 and 3 ($N = 44$) were reported to watch 1.0 to 40.0 hr per week ($M = 12.0, SD = 8.0$). The children who watched very little television (because of lack of interest, according to the parents) nevertheless were exposed to television as other family members watched. They tended to watch for only a few minutes at a time, generally ignoring even children’s shows.

Examination of the data from the questionnaire revealed that, for our middle-class sample, success in the video task did not appear to be related to the amount of television the child watched, the family’s use of a videocamera, or the child’s exposure to videos of themselves. In the General Discussion, we outline possible reasons for this result.

**EXPERIMENT 1A**

One of the most intriguing aspects of the development of the ability to use symbols is the cause of children’s rapid progress. As described above, there seem to be rather sudden advances in children’s ability to detect and exploit the symbolic relation between a picture, video image, or scale model, and its referent. DeLoache (1995a, p. 100) proposed that experience with various symbols leads to the development of *symbolic sensitivity*, “a general readiness or proclivity to interpret a novel entity primarily in terms of something other than itself.”

Support for this idea has come from a series of transfer studies (DeLoache, 1991; Marzolf & DeLoache, 1994). In these experiments, children who were first given experience with an easy symbolic relation later succeeded at a task that their age group usually fails. For example, in one study, 2½-year-olds first participated in the object retrieval task using pictures, followed by the scale model task a day later.
These children did substantially better on the model task than a control group who received the model task first (DeLoache, 1991).

To see whether prior success in the video task would assist children in solving the more difficult model task, the older group from Experiment 1 returned a second day to participate in the model task.

Method

Participants. The transfer group consisted of the 12 2½-year-olds (29.0 to 32.5 months, $M = 30.6$ months) from Experiment 1. Control data came from eight 2½-year-olds (29.5 to 32 months, $M = 30.5$ months) who had participated in a model task on 2 days (Marzolf, Pacha, & DeLoache, 1996).

Materials. The same two adjoining rooms were used as in Experiment 1. In place of the video monitor, a scale model (84 × 73.5 × 33 cm) of the large room sat on the floor of the control room (Figure 1b), aligned in the same spatial orientation as the room. The model duplicated all the main features and furnishings of the room, including carpeting, cabinetry, and tiny reproduction prints on the wall. The miniature and full-sized furniture were highly similar: For example, both small and large armchairs were covered with the same fabric. The arrangement of the furniture in the model and room was the same. The objects that were hidden in the model task were a small plastic dog (2 cm high) and the larger stuffed dog (15 cm high) used in Experiment 1.

Procedure. The procedure was the same as that used in numerous earlier model studies. Children in the transfer condition returned to the laboratory 1–2 days after their first (video) session. Children in the control condition had two experiences with the model task, separated by 1–2 days (providing a baseline of possible improvement due to general familiarity with the testing situation). All sessions lasted about 30 min. After a brief warm-up activity, the child was given an extensive orientation during which the correspondence between the two toys and between the room and model was explicitly described and demonstrated. The orientation included taking all the miniature pieces of furniture into the large room and holding each one up against its counterpart, explaining that they were just the same except for size. An imitation placement concluded the orientation.

Following the orientation, there were four trials on which participants were required to find the large toy in the room, based on where they had seen the miniature toy hidden in the model. The hiding locations were the same as those used in the video task, but this time children received the opposite order of hiding places.

On each trial, the child watched as the experimenter hid the miniature toy in the model. The experimenter always called the child’s attention to the act of hiding, but never labeled the hiding place: “Look, Little Snoopy is going to hide right behind [in, under] here. I’m going to help Big Snoopy hide in the same place as Little Snoopy, and then you can come find him.” After the experimenter had hidden the larger toy, the child was encouraged to search for it in the room (retrieval 1). As in the video study, if the toy was not found on the first search, hints were given so that the child eventually found the toy, but only the first search was counted. After the child retrieved the large toy, he or she was taken back to the model and asked to retrieve the miniature toy hidden at the beginning of the trial (retrieval 2). For further details of the standard model task used here, see Marzolf and DeLoache (1994).

Results and Discussion

The results of Experiment 1A provide clear evidence of transfer. Figure 3 shows the mean level of errorless retrievals for the transfer and control groups. On day 1, as expected, the performance of the transfer group in the video task (79%) was superior to that of the control group in the model task (16%). Both groups participated in the model task on day 2. The transfer group, which had experienced the video task first, did much better (60%) than the control group (31%). The performance of the control group across days was similar to that of other 2½-year-olds.
in previous transfer studies (Marzolf & DeLoache, 1994).

Both transfer and control groups performed well on retrieval 2 of the model task, that is, remembering where the original toy was hidden in the model, consistent with the results of previous studies. Therefore, the poor performance of the control group on retrieval 1 could not be due to forgetting where the small toy was hidden or to lack of motivation to search.

The data were analyzed in a 2 (condition: transfer versus control) × 2 (gender) × 2 (day) mixed ANOVA, with day as a within-subject variable, adjusted for unequal cell size. The main effect of condition was significant, \( F(1, 16) = 20.08, p < .001 \), with the transfer group performing better overall than the control group. There was also a significant condition × day interaction, \( F(1, 16) = 13.30, p < .01 \). Simple effects tests (e.g., Kirk, 1982) of the interaction revealed lower performance in the model than the video task for the transfer group, \( F(1, 16) = 9.89, p < .05 \), but no difference in the control group’s performance in the model task across days.

Significant interactions also occurred for condition × gender, \( F(1, 16) = 5.60, p < .05 \), and day × gender, \( F = 6.46, p < .05 \). The basic difference was that on day 2, the girls in the transfer condition performed better (88%) than the boys in the transfer condition (33%) and better than either sex in the control condition (both 31%). Gender effects have rarely been found in the large number of previous model studies; however, girls performed better than boys in a previous transfer study (Marzolf & DeLoache, 1994, Experiment 3). Further research is needed to determine the reliability of this gender effect for symbolic transfer.

The predicted transfer effect was tested in follow-up univariate ANOVAs (condition × gender). On day 1, as expected, performance in the video task was significantly better than in the model task, \( F(1, 16) = 25.55, p < .001 \). On day 2, the transfer group was significantly more successful than the control group, \( F(1, 16) = 8.48, p < .05 \). Thus, children who had first experienced the relatively easy video task were successful with the more difficult model task, compared to children who experienced the difficult model task twice.

Individual performance was consistent with transfer. According to the transfer hypothesis, only if a child was successful on day 1 should he or she succeed on day 2. Of the nine children (six girls, three boys) who succeeded on the video task—that is, were correct on three or four of the four trials—five (all girls) were equally successful on the difficult model task. In contrast, none of the three children who were unsuccessful on the video task succeeded on the subsequent model task.

Five of the 12 2½-year-olds therefore succeeded on a task that children of this age normally fail. Having first recognized that a video image of events in a room corresponded to the actual events, the children were sensitive to the relation between a scale model and the room. Thus, some very young children are helped to appreciate a nonobvious symbol-referent relation by prior experience with an easy one. However, detecting such a relation is basically difficult and uncertain for children of this age, and some remain oblivious to it.

In summary, the results of Experiments 1 and 1A thus provide evidence of very young children’s ability to use a video display as a source of information about the outcome of an event. As we had expected, 2½-year-old children were very successful at exploiting the informational potential of video; they clearly interpreted the televised event they saw as relevant to a real event. Furthermore, having recognized the connection between events on video and events in the real world, they subsequently detected and exploited a different, more difficult symbolic relation. The 2-year-old children in Experiment 1 were less successful in the video task, and we focus on factors underlying their difficulty in Experiments 2 and 3.

**EXPERIMENT 2**

More often than not, the 2-year-olds in Experiment 1 did not take advantage of the symbolically presented information. Most of them had difficulty relating the hiding event they saw on the video monitor to the location of the toy in the room. If the 2-year-olds’ poor performance stemmed specifically from having to recognize the connection between a symbolic medium and reality, then they should do better if they experienced the hiding event directly. To test this idea, we had 2-year-old children watch a series of hiding events directly through a window rather than on a video monitor.

**Method**

Participants. Eight 2-year-old children (24.0 to 26.0 months, \( M = 24.6 \) months) participated, including four boys and four girls. None had taken part in Experiment 1.

Materials. This study took advantage of the fact that there was a large window in the wall between the experimental and control rooms (Figure 1c). (It had been covered with a curtain throughout Experi-
ment 1.) In Experiment 2, children could see from the control room to the larger room through an opening the same size (40 × 30 cm) as the screen of the video monitor used in Experiment 1. To create this view, the window was covered with black paper except for the opening that was also the same height from the floor as the monitor screen had been. Because of the location of the window, this opening was 1 m to the left of the location of the video monitor in Experiment 1. The window allowed a clear view of all the furniture in the room. The object that was hidden was the same stuffed dog as in Experiment 1.

Procedure. The procedure duplicated that of the video study as closely as possible. During the orientation, the experimenter labeled the toy dog and all the items of furniture in the room. Then she pointed to the window between the rooms, suggesting, “Let’s go look through the window.” The child accompanied the experimenter to the control room, and the experimenter pointed out and labeled all of the furnishings as the child looked at them through the window (just as the experimenter had identified the items on the video monitor in Experiment 1). As in the video study, the child was asked to imitate the placement of the toy after watching (through the window) the assistant place it on the coffee table.

Following the orientation, there were four trials on which participants were asked to find the toy in the room after they saw it being hidden through the window. All aspects of the procedure, including the manner of the assistant’s hiding of the toy and the narration supplied by the experimenter, were the same as in Experiment 1. The session lasted about 20 min.

Results and Discussion

All eight of the 2-year-olds who watched the hiding events through the window performed perfectly. Thus, identical events produced dramatically different behavior, depending on whether the event was observed directly or on live video. All the 2-year-olds who watched a hiding event through a window in Experiment 2 immediately retrieved the toy on every trial (M = 100%), whereas most of the 2-year-olds who had watched exactly the same event on a video monitor in Experiment 1 usually searched in the wrong place (M = 44%).

Why is it so difficult for 2-year-olds to use a video event as a guide to an existing situation? One possible reason could be perceptual—the need to map spatial relations between a two-dimensional video image and a three-dimensional room.

Another factor that might hinder young children’s detection of the video-reality connection is, paradoxically, their knowledge and expectations about television. By the time children become participants in our experiments, most have been exposed to hundreds of hours of television and videos. Presumably, one thing they have learned is that television has little to do with their immediate experience. When children are looking for a lost toy, they cannot ask a character on television to show them where it is. A learned assumption that television is decontextualized might lead 2-year-olds to interpret the televised hiding events in our laboratory as entertainment, as a “TV show,” rather than as potential source of information about current reality.

Experiment 3 provided a test of both these possible explanations of the children’s relatively poor performance. We reasoned that if children thought they were watching a hiding event directly through a window, when they were actually watching video, there would be no need to recognize the connection between a video image and reality. Hence, this procedure would eliminate any possible effect of their expectations about television. If the 2-year-olds’ prior expectations about television were a major factor in their failure in Experiment 1, then children in this video window situation should be more successful than children who knew they were watching a television. At the same time, if the two-dimensionality of the video display were a problematic factor, then telling children that they were looking through a window should have little or no effect, because they would still actually be watching the same two-dimensional video image.

EXPERIMENT 3

There were two conditions—standard video and video window. Standard video was basically a replication of Experiment 1 with a few procedural modifications to provide an appropriate control condition. Children in the video window condition were told they were going to watch through a window to see the assistant hide the toy in the other room; however, they were actually seeing a video image through the window. Therefore, children in both conditions watched the identical hiding events on video. The only difference was that one group of children knew they were watching video, whereas the others were told they were looking through a window. (The video window condition is based on the same logic used by DeLoache et al. [1997] in a study in which 2½-year-olds were led to believe that a shrinking machine could transform a real room into the scale model of the room.)
Figure 4  The physical arrangements for Experiment 3. In the standard video condition (a), children watched the hiding events on the video monitor in the control room. In the video window condition (b), children were told they would watch the hiding events through the window between the rooms. The video monitor was secretly moved behind the window after the child left the room.

Method

Participants. Thirty-two 2-year-old children, including 16 boys and 16 girls, participated in one of two conditions: video window (23.5 to 25.5 months, \( M = 24.2 \) months) or standard video (23.5 to 25.5 months, \( M = 24.3 \) months). Half of the boys and half of the girls were assigned to each condition. None had taken part in the earlier studies. Two additional participants were eliminated: one was extremely inattentive, and one said “TV” when she first saw the video image through the window, indicating she was not influenced by our instructions (see below).

Materials. Unlike Experiment 1, in which the camera was panned to show all the furniture in the room and to follow the movements of the assistant, the camera remained stationary. A subset of the furniture present in Experiment 1 was used, and it occupied a smaller space in the room (Figure 4a). This was done so that all the furniture could appear on the monitor at once. The items of furniture were the round table covered with a tablecloth, the large armchair, the end table, and the basket, plus a large floor pillow and an area rug.

The video camera was again connected to the monitor so the picture was “live.” In the video window condition (see Figure 4b), the window was covered with black paper except for a 26 \( \times \) 34 cm opening cut in the paper. The camera sat next to the monitor on a rolling cart. During the orientation, the cart was hidden behind a floor-to-ceiling cloth divider at the side of the room. After the child and experimenter left the room at the beginning of each trial, the monitor and camera were placed directly behind the window. The monitor screen exactly filled the cut-out opening, thus ensuring that the body of the monitor was not visible through the window. The monitor had good color reproduction and no glare. Thus, the view was similar to that obtained by looking through the window, except that it had the limitations of a video image: it lacked motion parallax (moving the head did not change what was visible) and binocular disparity (there was virtually no difference in the images detected by the two eyes), and the field of view was reduced (the furniture appeared larger than in the direct view, and the periphery of the room was not visible).

The window between the two rooms was covered by a curtain. In the video window condition, the curtain remained closed until the monitor was in place behind the window on each trial. In the standard video condition, the curtain was always closed, so that the only view of the room was via the monitor.

The toy that was hidden was a small dog that made a squeaking noise when it was squeezed. A
cardboard box with a hinged lid sat on the area rug during the orientation; it was used as a hiding place for a practice trial and was then removed.

Procedure. In the standard video condition, the procedure was the same as that used in Experiment 1, with three exceptions. First, the new furniture arrangement required a new set of hiding locations; these were in the basket, under the tablecloth on the round table, under the floor pillow, and under one of the cushions on the armchair. As usual, two orders of hiding places were counterbalanced across gender and condition. Second, a different kind of practice trial was used. We wanted to ensure that our 2-year-old participants understood what they were supposed to do on the retrieval trials. Therefore, at the end of the orientation, the experimenter hid the toy in the cardboard box while the child watched. Then the experimenter and child went into the control room and "counted to five," after which the child was asked to return to the room and retrieve the toy from the box. This practice trial was thus a memory-based retrieval, a task at which children of this age are highly competent (DeLoache & Brown, 1983, 1984). Finally, in an effort to center children's attention on the hiding events, on each trial the assistant squeaked the toy before hiding it.

Except for the same three modifications, the video window procedure was virtually identical to the real window situation (Experiment 2). After the orientation, the experimenter explained that the assistant would hide the toy in the room, and "We can watch her through the window." To begin the first trial, the experimenter and child went into the control room. The experimenter opened the curtain revealing the window and oriented the child to the hiding event visible through it, commenting, "Look, she's hiding the dog right there!" When the toy had been hidden, the experimenter closed the curtain; after a 10 s delay, the child was asked to go into the room and find the toy.

The major differences between the real window and video window procedures occurred "behind the scenes." The child was actually watching the video screen through the window. As soon as the experimenter and child had entered the control area and closed the door to the room for the beginning of the first trial, the assistant rolled the cart containing the monitor and camera out from its hiding place and positioned the monitor directly in front of the window. When the monitor was in place (approximately 10 s later), the assistant signaled the experimenter to open the curtain. After the child watched the hiding event, the experimenter closed the curtain, and the assistant quickly rolled the cart behind the divider before opening the door and inviting the child to search for the toy. This sequence was repeated for each trial. Thus, the child never saw the video monitor or camera.

As usual, if the child did not find the toy on the first search, increasingly explicit prompts were given so that the child eventually succeeded on each trial, although only the first search was counted.

Results and Discussion

This study was designed to test the idea that 2-year-olds' performance on the video task would be better if they did not realize they were watching a video, that is, if they were told they were looking through a window when they were in fact watching video.

The results of Experiment 3 support our hypothesis. The standard video group performed as poorly (41%) as did the 2-year-olds in Experiment 1 (44%), providing a replication of those results in a slightly different situation. Mean performance in the video window condition was 63%, but the distribution was bimodal, as shown in Figure 5. A chi-square test revealed that the pattern of performance differed significantly in the two conditions: Nine of 16 video window participants had perfect scores, compared to only three of 16 standard video participants, $\chi^2(1, N = 32) = 4.8, p < .05$. Thus, more than half the children who were actually watching video, but were told they were looking through a window, performed perfectly—just like the children in Experi-

![Figure 5](image-url)
ment 2 who observed the hiding events directly through the window.

It should probably not be surprising that mean level of performance in the video window condition was not closer to that of the real window study (100%). Although the procedure was designed to convince children they were directly watching a hiding event, the extent to which the children believed they were simply looking through a window is unknown. Six adults who observed the video window all realized they were seeing a video image. One child (who was eliminated from the study) explicitly said “TV!” the first time the curtain was opened. Therefore, it is possible that some of our participants realized they were watching video, and others may have simply been confused about the nature of the display. Because both possibilities would work against our hypothesis, the fact that our manipulation produced the predicted result—better performance by children who had been told they were observing an event directly—is particularly strong.

In further support of our explanation, the results are consistent with those of a scale model study based on the same logic (DeLoache et al., 1997). Children were led to believe that a “shrinking machine” transformed a real room (a tentlike portable room) into a model of the room. The reasoning was that if children believe the model and room are one and the same entity, then finding the toy does not depend on recognizing a symbolic relation between the two; rather, the model is the room. The prediction that 2½-year-olds would do better than in the standard model task was confirmed. Thus, removing the need to recognize the connection between a symbol and its referent made both the video and the model tasks easier for young children.

The results indicate that perceptual factors are not a major source of 2-year-olds’ problems with the video task. Although it may be somewhat difficult for children of this age to map spatial relations between a degraded two-dimensional video image and a three-dimensional room, more than half of the video window participants perfectly mapped between the video image and the room. The results of this study therefore support the hypothesis that a major source of 2-year-old children’s poor performance in the standard video task was their expectations about the video medium: A learned assumption—that television is unrelated to present reality—predisposed them to miss the connection between the live video hiding event and the location of the toy in the room next door.

As in Experiment 1, the most common kind of error in Experiment 3 was returning to the place where the toy had been hidden on the previous trial (standard video, 55%; video window, 71%). Could it be that the 2-year-olds recognized the video-reality connection, but were merely unable to inhibit a tendency to revisit the previously correct location?

Two aspects of the data suggest that deficient inhibition was not a major factor in their poor performance. First, the 2-year-olds in Experiments 1 and 3 self-corrected their perseverative errors only 25% of the time: After returning to the previous place and finding it empty, they typically did not search where they had seen the toy hidden on the video. (The self-correction rate for other types of errors was 8%) Second, the 2-year-olds who watched identical hiding events directly through the window in Experiment 2 never were impelled to return to the previous location (100% correct performance). When 2-year-olds knew where to search, perseveration is not a problem. Therefore, it is unlikely that poor inhibitory abilities masked symbolic competence on the part of the 2-year-olds in the standard video task.

It is worth noting that the procedural modifications used for the standard video condition in Experiment 3 did not improve performance over that achieved by the 2-year-olds in Experiment 1. In particular, the camera was not panned as it was in the first study. Camera movement is a convention of video (e.g., Greenfield, 1984), and one might have expected it to have an effect. There was also no apparent impact of the other changes made in Experiment 3, including the practice retrieval trial, the smaller number of possible hiding places, and the attempt to draw children’s attention to the hiding event by squeaking the toy. This indicates that 2-year-olds’ problems in the video task are substantial and not easily overcome.

GENERAL DISCUSSION

The results reported here contribute to our understanding of early symbolic development in general, as well as to what is known about young children’s understanding of the video medium in particular. The pattern of results is consistent with and extends the account of early symbolic development offered by DeLoache (1995a, 1995b).

It is important to emphasize that the specific challenge of our task for young children is the need to take information from a symbol as information about the real world. Specifically, children have to infer the existence of a particular state of affairs based on knowledge acquired from a symbol. Young children
respond meaningfully to symbols well before they are capable of taking a symbol as a source of information about a real situation. For example, infants as young as 3½ months respond similarly to video images of their mothers’ faces as to their mothers themselves (Hayes & Watson, 1981; Murray & Trevarthen, 1989). Five-month-olds recognize pictured objects and people (DeLoache, Strauss, & Maynard, 1979; Dirks & Gibson, 1977). As Meltzoff’s work (1988) has made clear, older infants and toddlers can learn to perform novel actions on novel objects from video displays.

Poor performance in our object-retrieval task is interesting in light of the good performance of young children in imitation studies using video (McCall et al., 1977; Meltzoff, 1988). We think that the crucial difference is the need to form a mental representation of an existing situation (the location of the toy in the room) and to use that representation to guide one’s behavior. To succeed on the retrieval task, children must use the event they observe on the screen as information about the location of an object in the real world. In contrast to the imitation studies, our research requires children to recognize the connection between live video and current reality.

This connection is not transparent to very young children. Even though we made extensive efforts to explain and demonstrate the relation between the real events in the room and the televised events on the monitor, our 2-year-old participants failed to detect that relation. The majority did not reliably use the video as a source of information about where to search for the hidden toy. As in other studies using this general approach, these 2-year-olds understood that there was a toy hidden in the room and that they were supposed to find it. The only aspect of the situation that escaped their notice was the fact that the televised event could tell them where to search. Their problem was specific to the video-mediated presentation of information: All the 2-year-olds who watched the same hiding events directly through a window always found the toy.

Consistent with prior research with other symbols, there was a substantial difference between the performance of two groups only 6 months apart in age (DeLoache, 1987; DeLoache & Burns, 1994). In contrast to the 2-year-old children, the 2½-year-olds readily used video as a source of information about the current location of the toy. In addition, the transfer from the video to the model task was expected, based on previous transfer studies (DeLoache, 1991; Marzolf & DeLoache, 1994; Marzolf et al., 1996).

A particularly high degree of consistency is evident in the similarity between the results reported in Experiment 1 for video and several previously reported picture studies (DeLoache, 1987, 1991; DeLoache & Burns, 1994). In both cases, 2½-year-old children were very successful, but 2-year-olds were not. The only difference is that the performance in the video task seems to be somewhat higher than that in the task using still pictures, a difference presumably attributable to the greater informational content of video.

Our account of the pattern of results for video is similar to that offered previously for pictures (DeLoache & Burns, 1994; DeLoache, Pierroutsakos, & Troseth, 1996). We think that symbolic experience—both specific video experience and general symbolic experience—generates competing tendencies that underlie the observed pattern. By the time 2-year-old children take part in our experiments, most of them have been exposed to many hours of television. Presumably they have learned that the world on the screen does not affect their immediate experience. Although Mr. Rogers talks directly to the “boys and girls” watching, he is never at the same location with them, and his on-screen actions have no effect on the objects around them. Also, parents actively teach their children that things seen on television are “not real.” Children are told not to be afraid of vividly presented monsters, dinosaurs, and aliens because “it’s just TV, it’s pretend.” A learned assumption that events on television are merely entertainment, separate from the real world, may make it difficult for 2-year-olds to recognize that a live video presentation in our laboratory contains information about events in the room next door.

One might expect the amount of home exposure to video to be related to performance in the object retrieval task. In our middle-class sample, however, neither hours of television viewed per week nor experience with home video (based on parent report) distinguished between the children who succeeded and those who failed our video task. It is possible that the lack of relation is an artifact due to the small sample size and/or that our video measure was not refined enough. For example, we did not routinely ask parents how attentively the children watched. A second possibility is that it takes only a small amount of exposure to television to convince children that things appearing on a video monitor have no immediate connection with present reality. The best test of our account would use as participants children from a culture with no exposure to video. We would predict that video-naïve children would do better on the object-retrieval task than our middle-class American
sample. Of interest, our participants had little exposure to the one kind of video that might have been expected to make the video-reality connection more apparent—home videos of themselves and their families.

If the failure of the 2-year-old children in the video task has to do with their prior experience with television, then why did 2 1/2-year-olds succeed? Surely this older group had even more exposure to video (Anderson & Lorch, 1983; Carew, 1980), yet they apparently recognized the connection between the video presentation and reality. The answer may be that the 2 1/2-year-olds had also had more general symbolic experience, that is, more exposure to a wide variety of symbols and symbolic activities.

In modern, Western societies, young children regularly encounter symbols such as print, numbers, pictures, video, and so forth. They see their parents and older siblings reading books, writing lists, drawing pictures, filming family videos. Most very young children (and even many infants) have extensive experience with picture book reading interactions with parents, teachers, and older siblings (Gelman et al., in press). They learn to identify symbols for their favorite toys, movies, and restaurants (e.g., the Batman bat, the Disney castle, the “Golden Arches”).

In the third year of life, young children serve increasingly often as apprentice symbolizers. They begin to take a more active, creative role in pretend play with parents and siblings (Dunn, 1991). Also, children begin to scribble and attempt to draw; although their attempts are not initially understandable to others, they are developing the concept of graphic representation (Kellogg, 1969). Thus, young children increasingly often adopt a symbolic stance to objects and events (Liben, in press).

We propose, therefore, that symbolic experience has two contrasting effects. On the one hand, children's early experiences lead to conservative expectations about how particular media are used. Children learn the conventional role of video images and pictures and do not expect them to provide information about a current situation. On the other hand, experience over time with many different kinds of symbols increases symbolic sensitivity; that is, children become more likely to entertain the possibility that a new entity is a representation of something other than itself and to accept a novel use of a familiar type of symbol (DeLoache, 1995a).

Support for our argument about the role of prior experience in the video task comes from the results of Experiment 3. Two-year-olds who watched a hiding event on a television monitor usually failed to find the hidden toy. Two-year-olds who watched the identical event on the same television monitor, but who were led to believe that they were watching the event directly through a window, performed better. Thus, expectations about the nature of televised events seems to have influenced children who knew they were watching television to discount the relevance of what they saw for the immediate situation. When it was not clear that the event was a video image, the children extracted information from it.

Further support for our account comes from an earlier video study conducted in our laboratory. It was in many ways like the studies reported here, except that instead of a live video display, the 2 1/2-year-old children saw a pretaped film in which an actress spoke to them in the manner of Mr. Rogers and then hid the toy. The children never saw the actress in person, and the connection between her actions and events occurring in the laboratory was not clearly specified. Thus, this situation was essentially like a television show. Unlike the 2 1/2-year-olds in the present research, the participants performed very poorly; they failed to take the pretaped video as information about the location of the hidden toy.

Converging results also come from a recent pilot study by Schmitt (1997), who created a video display resembling a children's television program. She showed 2- and 3-year-olds video presentations in which toy animals appeared to hop or walk to a piece of furniture and hide themselves behind it. There was background music, and the animals "talked" in a voiceover. When the children were asked to find the puppet in the room next door, the performance of both age groups was quite poor—16% for the 2-year-olds and 44% for the 3-year-olds.

We thus see that making a video display more like a standard television program leads to relatively poor performance by young children. In contrast, obscuring the fact that a display is actually televised improves performance. We interpret this as evidence that very young children are inclined to segregate their mental representation of a televised event from their representation of events in the real world.

Analogous results also occur with older children. For example, Raessi and Wright (1983) found that preschool children may discount video-presented information about reality unless they are specifically encouraged to take the video seriously. They showed children video presentations that included the solutions to Piagetian conservation tasks. If an adult co-viewer encouraged involvement with the video, the children were later able to solve conservation problems with real objects. If the children watched alone, they did not succeed on the subsequent tasks. This result is consistent with Salomon's (1981, 1983) pro-
proposal that children may not invest much mental effort in getting information from video because they assume the medium is entertainment and does not require concentration. Although our account is different from Salomon's, it seems compatible.

Finally, we should note that children's difficulty interpreting video-reality relations extends to their interpretation of a video image of themselves. When Ayme Warren (personal communication, May 27, 1997) allowed 3- and 4-year-olds to see a video playback of themselves participating in a study, they sometimes made comments such as, "That boy has on shoes just like mine," and "That boy can't do it, but I could." Although the events they saw had occurred within the previous half hour, these children did not appear to realize that they were watching themselves. Similarly, Povinelli, Landau, and Perilloux (1996) recently showed 2- to 3½-year-old children a delayed (by 3 min) video of themselves with a large sticker on their heads—put there minutes before by the experimenter. Most of the children did not reach up to remove the sticker, as children did who watched a live video. Some of those who saw themselves on delayed video referred to their own image in the third person, commenting, for example, that there was a sticker on "her head." The lack of contingency appeared to disrupt the children's self-recognition, negating the video's potential as a source of information "about themselves that was previously unknown" (p. 1553). Our research suggests that the children's problems in the self-recognition task may have stemmed in part from their level of understanding of the video-reality connection in general.

It is interesting to consider our results in light of the good performance of nonhuman primates on object-retrieval tasks employing video. Vauclair (1996) had adult baboons watch a live video presentation of an experimenter hiding a nut under one of an array of 50 rocks in an enclosure. The baboons achieved a high level of successful retrievals. In a similar experiment by Menzel et al. (1978), infant chimpanzees who had watched on video as a familiar caretaker hid a nut in an outdoor field usually succeeded in finding the caretaker.

Why were our 2-year-olds less successful than primates in using information from video to find a hidden object? Unlike our participants whose experience with television led them to discount the video information, none of the primates had previously been exposed to video and they may have responded to the video images as if they were real. Menzel et al. (1978) commented that the chimpanzees in their video study behaved as they normally would have if they had been watching a familiar person directly: They visually tracked the image of the caretaker, pointed at the image and made "food grunts" when the caretaker held up some food; and on a few trials, they whimpered and tried to escape at the instant the caretaker disappeared over a hill in the outdoor field. Thus, we suspect that children and primates who solve object-retrieval problems with video do so in very different ways.

In conclusion, we want to point out the relevance of the research reported here to the common practice in developmental psychology of using video displays, including highly stylized computer-generated ones, as stimuli. It is commonly assumed that their connection to reality is transparent to the viewer—whatever his or her age. We are certain that this assumption is sometimes fully warranted, and we are equally certain that sometimes it is not warranted. We concur with Ittelson's (1996) caution about the dangers of "the pictorial assumption" and the need for careful evaluation of when pictures and videos are appropriate as stimuli, and when they are not.

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