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Don’t Try This at Home: Toddlers’ Imitation of New Skills from People on Video

Gabrielle A. Strouse and **Georgene L. Troseth**
Vanderbilt University

Abstract

Imitation of people on educational television is a potential way for very young children to learn new skills. Although toddlers in previous studies exhibited a “video deficit” in learning, 24-month-olds in Study 1 successfully reproduced behaviors modeled by a person who was on video as well as they did those modeled by a person who was present in the room (even after a 24-hour delay). Neither displaced filming context nor cuts between actions affected toddler’s imitation from video. Shortening the demonstration in Study 2 affected imitation in the video condition but not in the live condition. In Study 3, 24-month-olds who viewed the original, longer videos on their family TV (with which they had a viewing history) imitated significantly less than those who viewed the videos on the lab monitor. Imitation of a live modeler was the same across settings (home or lab). Implications for toddlers’ judgments of reliable information sources and for the design of educational television programs are discussed.

Keywords

Representation; symbol; imitation; social cognition; video; television

A distinguishing feature of human cognition is the ability to take advantage of the knowledge and skills of more experienced individuals (Tomasello, Kruger, & Ratner, 1993). Infants nearing their first birthday start to participate in the “referential triangle” in which they share focus with another person on an outside object. They become increasingly adroit at using others’ social cues to learn about the world during the next year of life (Baldwin, 2000; Baldwin & Moses, 2001). Watching other people’s actions, infants begin imitating what they do with objects. Children imitate to learn and also to communicate and identify with social partners (Meltzoff & Moore, 2002; Už, 1981).

Twenty-first century children in industrialized countries also see people on video screens, and potentially could take advantage of knowledge and skills presented there. An avalanche of video products, including *Brainy Baby*, *Baby Einstein*, and “BabyFirst TV” (a 24-hour-a-day television network), have claimed to promote learning in very young children. In a recent survey, the majority of American parents with children aged 2 to 6 believed that baby videos positively affect development (Rideout, 2007).

Correspondence address: Peabody College, #512, 230 Appleton Place, Nashville, TN 37203-5721, Phone: (615) 322-1522, Fax: (615) 343-9494, gabrielle.a.strouse@vanderbilt.edu, georgene.troseth@vanderbilt.edu.

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Video might seem to have potential as a teaching tool: it is perhaps the most iconic symbolic medium, maintaining the color, shape, and relative position of depicted objects. It also represents motion, allowing the clear depiction of events (Troseth, Pierroutsakos, & DeLoache, 2004). Video can show people's behavior, including social cues such as facial expression and pointing, with accompanying sound tracks providing further verisimilitude. The question is whether very young children actually learn from video as they do from real people and events.

Research has revealed that children under the age of 3 who are given information on video often do not perform as well on measures of learning as those getting the same information directly. Toddlers have trouble using information appearing on a TV screen to learn new words (Krcmar, Grela, & Lin, 2007), solve problems (Troseth & DeLoache, 1998; Schmitt & Anderson, 2002; Deocampo & Hudson, 2005), recognize themselves (Povinelli, Landau, & Perilloux, 1996; Skouteris, Spataro, & Lazaridis, 2006; Suddendorf, 1999; Suddendorf, Simock, & Nielsen, 2007; Zelazo, Sommerville, & Nichols, 1999), and imitate new skills (McCall, Parke, & Kavanaugh, 1977; Barr & Hayne, 1999; Hayne, Herbert, & Simcock, 2003), yet find these tasks trivially easy if they get the information directly. Anderson and Pempek (2005) term this pattern of results "the video deficit".

There are several potential reasons why very young children exhibit this difference in learning. When children interact directly with another person, they look to him or her for information about the shared environment (Baldwin & Moses, 1996). However, people on television do not share focus on elements of the viewing child's environment and cannot respond if a child attempts to communicate with them. During the middle of the first year, children become sensitive to the lack of interpersonal contingency exhibited by a person on a pre-taped video and begin to respond differently than they do to a person who is present (Bigelow, MacLean, & MacDonald, 1996; Hains & Muir, 1996). To the young child, "Persons are special entities, the only entities in the world with whom I can share behavioral states" (Meltzoff, Gopnik, & Repacholi, 1999, p. 35). Yet people on television provide at best a "non-contingent, quasi-social" situation for the viewer (Hollenbeck & Slaby, 1979, p. 45). Due to their experiences watching television, toddlers may rule out people on video as social partners who might offer relevant information.

A second potential contributor to the "video deficit" involves children's developing, but incomplete, concepts about the symbolic function of video images and other representational artifacts (Pierroutsakos & Troseth, 2003; Tomasello, 1999). The *dual representation* hypothesis (DeLoache, 1987, 1991, 2000) focuses on the dual nature of objects (such as scale models or video images) that have concrete qualities but also represent something else. For instance, a scale model is a miniature object or set of objects whose main function is to represent a larger space.

DeLoache (1987) had children watch an adult hide a miniature toy in a scale model of a room, then asked them to find a larger, matching toy in the room itself. To do so, children needed to realize that the model provided information—it "stood for" the room. Across 4 test trials, 36-month-old children easily retrieved the toy, but 30-month-olds had great difficulty doing so. Neither age group had trouble finding the toy they had seen hidden in the model itself, showing that the younger children's problem was not memory but a failure to use that event to infer what had happened in the other space. DeLoache reasoned that the younger children focused on the concrete qualities of the scale model itself (i.e., they viewed it as a toy) and did not also recognize its role as a symbol for something else.

As applied to video, dual representation entails thinking of a video image not merely as "something on TV" (the context in which children typically experience video) but also as a potential representation of something real, beyond the frame of the TV set. In a video version of the search task (Troseth & DeLoache, 1998), after watching on a video monitor as an adult hid a toy in an adjoining room, 24-month-olds did not reliably use what they saw on the screen to find the toy on 4 test trials. However, children of the same age always found the toy after watching through a small (monitor-sized) window between rooms. Also, telling children that they were watching through a window (when they really were watching a video screen that had secretly been put behind the window) improved their retrieval of the toy, compared to the low retrieval scores of children who saw the monitor and knew they were watching video. Because children in both conditions watched the same 2-dimensional video, it seemed that their expectations about video affected their use of information presented there.

For video images, scale models, and other representational artifacts, experience may play an important role in children's detection of the symbolic relation between object and referent. When DeLoache (2000) allowed 36-month-old children to play with the model as a toy before starting the symbolic task, they were less successful than children who had no such play opportunity. Providing experience that echoed children's play with their own miniature toys made it more difficult for them to use the model as a source of information about the room. However, when DeLoache made the model inaccessible behind a pane of glass (de-emphasizing its potential as a toy), 30-month-olds found the hidden object significantly more often than children of this age did who saw the model out on the floor and accessible to them (the standard condition). This research supports the idea that very young children have trouble thinking about an object as a symbol when prior experience predisposes them to interpret it in a different way.

What might very young viewers' experience with television lead them to conclude about video? Video images on television often contradict toddlers' world knowledge (e.g., on TV, animals talk). On-screen events usually have no relation to children's ongoing experience, and people on video are not socially responsive to the viewer. Because toddlers have not experienced a reliable symbolic relation between events on television and reality, they may not expect what they see on the screen to be a viable information source.

However, given the perceptual similarity of video to reality, young viewers may nevertheless make sense of and remember what they see on the screen. Although toddlers exhibit the "video deficit" across many tasks, this does not mean that *no* learning occurs. On the first trial of the search task, toddlers are relatively successful at finding the hidden toy (Schmitt & Anderson, 2002; Suddendorf, 2003; Troseth, Schmidt, & Anderson, 2006); it is on later trials, when they must *choose* between a memory from direct experience (where they found the toy previously) and a memory of what they saw on video (where the toy is currently), that 24-month-olds typically fail. Therefore, very young children do form memories of events seen on video that will sometimes guide their behavior, although not as robustly as a memory of live, unmediated experience will.

Deferred imitation of a person's behavior on video would also require that children form and later retrieve a memory. In a set of early studies, 14-month-old babies imitated a simple 1-step behavior that they had seen on video (Meltzoff, 1988) or from a person who was present (Meltzoff, 1985) at approximately the same rate (40% video; 45% live). However, in a large number of studies involving the modeling of more difficult, multi-step sequences, infants' and toddlers' level of imitation has consistently been lower following a video versus a live demonstration.

Barr (in press; Barr & Hayne, 1999; Barr, Muentener, Garcia, Fujimoto, & Chavez, 2007) reasons that *perceptual impoverishment* may contribute to the "video deficit". Because video images do not contain as many perceptual attributes (e.g., depth or textural cues) as real, 3-dimensional entities, children may not be able to encode a complete representation of a depicted event. According to Johnson's (2000) "threshold model" of object perception, people need both sufficient perceptual information and sufficient perceptual skills to determine the boundaries of objects in 2-dimensional images. Because young children's perceptual skills are not as mature as those of adults, children require more sources of perceptual information (e.g., depth, motion, color, edge cues) to interpret computer or video displays.

In general, perceptual information available when individuals encode an event can affect later retrieval of a memory. A close perceptual match across training and test situations helps young children to access their memories. For instance, 3-month-old infants reenact a learned behavior —kicking to get a mobile above their crib to move—more frequently if the surrounding crib bumper is the same during the training and test (Butler & Rovee-Collier, 1989); when surrounded by a different context, young infants have more trouble accessing the memory even though the main retrieval cue (the mobile) is exactly the same. With age, children imitate across greater changes in stimuli and context: changes in either the test stimuli or testing room affected 6-month-olds' delayed imitation of a sequence of steps involving toys, but only stimulus changes affected 12-month-olds, and neither change affected 18-month-olds (Hayne, Boniface, & Barr, 2000). In a delayed imitation task using a more difficult sequence of steps, generalization of learning to new stimuli was rare in 18- and 24-month-olds but more common in 30-month-olds (Herbert & Hayne, 2000). Hence, a mismatch in just a few perceptual cues can disturb the deferred imitation of children as old as two years.

Studies that probe learning from video by their nature involve a stimulus-to-retrieval-cue perceptual mismatch, because children observe a model on video but are presented with real stimuli at test. In a series of studies, Hayne and her colleagues (Barr & Hayne, 1999; Hayne, Herbert, & Simcock, 2003) consistently found less deferred imitation by 12- to 30-month-olds after they watched a person on video model a sequence of steps with a toy, compared to children's imitation following a demonstration by a person who was present in the room. According to the *perceptual impoverishment* hypothesis, because children in the video conditions saw a 2-dimensional depiction of the stimuli on day 1 and the real stimuli on day 2, visual cues missing from the video (such as depth and texture) may have made it more difficult for children to access the memory when they were given the real 3-dimensional stimuli, compared to children who saw the live demonstration. However, perceptual issues are unlikely to be the whole explanation for the "video deficit." Schmidt, Crawley-Davis, and Anderson (2007) reported that 24-month-olds still had difficulties in the object retrieval task when 2-D versus 3-D perceptual differences were minimized or eliminated. Toddlers' consistent success in the "video-behind-the-window" study (a 2-dimensional image disguised as a real event—Troseth & DeLoache, 1998), as well as their good use of information from video on the first trial of the "standard" video search task (Schmitt & Anderson, 2002; Suddendorf, 2003; Troseth et al., 2007) show that 24-month-olds *can* retrieve a memory of objects and events on video, but often do not use this information. However, task differences (e.g. the 24-hour delay in imitation studies) leave unclear whether both conceptual and perceptual factors might contribute to a video deficit in imitation.

In the studies described here, we used the deferred imitation paradigm to further explore the dual representation and perceptual impoverishment hypotheses. We began by investigating contextual features within the video itself that might affect children's learning. One notable difference between video research done in the laboratory (e.g., Troseth & DeLoache, 1998; Schmitt & Anderson, 2002; Troseth, Saylor, & Archer, 2006) and in the home (Barr & Hayne, 1999; Hayne et al., 2003) is the necessary background mismatch in the latter case. The backdrop against which the modeler appears (in the video or in person) can be carefully matched in the laboratory to be the same during demonstration and test. However, because it is impractical to film a new demonstration video for every participating child, children in imitation studies conducted in the home traditionally have seen a pre-taped video of a person filmed *in a lab* *room* (video condition), or a demonstration by a person present *in their living room* (live condition). The backdrop of the video therefore is: (1) unfamiliar to children, (2) different from the backdrop behind the live modeler (the child's own living room), and (3) different from the location where children are tested (their living room).

Given prior evidence of context dependent learning in infants (Hayne et al., 2000) and adults (Godden, & Baddeley, 1975; Smith, Glenberg, & Bjork, 1978), it is possible that toddlers who watched these "decontextualized" videos had difficulty retrieving the memory of the demonstration because they were provided with fewer contextual cues during the test than children who saw the live demonstration. In a study with live demonstrations only (Hayne et al., 2000) a change in context between demonstration and test did not hinder toddlers' imitation of a very simple sequence with a puppet, but this comparison has not been done in imitation studies with video. We therefore varied background context in a series of video conditions, following the delayed imitation procedures of Barr and Hayne (1999) and Hayne and her colleagues (2003).

Study 1

In Study 1, we included *live*, *video*, and *baseline* conditions similar to those in the prior studies, except taking place in a lab room. In addition, we included a new video condition, the *different context* condition, in which children saw an out-of-context video filmed in a different room that they would not recognize (typical of content seen on television). We predicted that children who saw the out-of-context video would imitate substantially less than children who saw the video filmed in the lab. This result would suggest that matching background context matters for toddlers' recall and imitation of video content.

As a further way to investigate imitation from video, we also included a *cuts* condition in which we manipulated the amount of information about the function of the parts of the toys (that is, how the pieces fit together) that children saw. Memory research indicates that toddlers encode information about the role of the constituent items (not just their appearance): after a delay, they spontaneously generalize behaviors modeled with one set of stimuli to a perceptually different but functionally equivalent set (Bauer & Dow, 1994; Bauer, Dow, Bittinger, & Wenner, 1998). They also form inferences about the stimuli, "filling in" missing steps in a modeled sequence, especially if the goal is demonstrated (Bauer, Schwade, Wewerka, & Delaney, 1999). The amount of information available to clarify the function of each of the pieces of the toy therefore might affect the strength of children's memory of a demonstrated sequence. In several of Barr's imitation studies (Barr & Hayne, 1999; Barr, Muentener, Garcia, et al., 2007), "cuts" were inserted into the video, removing the modeler's *disassembly* of the toys. We hypothesized that a video with this difference (not showing the toys being taken apart before they are put together again) would provide children with less information than the live (and continuous) demonstration did, and that this might negatively affect their reproduction of the actions. To test this, we included a *cuts* video condition.

Our main focus was on the imitation of individual behaviors as a measure of learning from video. Because viewing a person on video is not generally a social situation, the affiliative function of imitation may be lost to some extent. Nielsen, Simcock, and Jenkins (in press) report that after a live or video demonstration, 2-year-olds completed the same number of behaviors, but copied the modeler's exact methods less often when they had watched the person on video. Therefore, we also looked for evidence that children were imitating the exact sequence of steps they had observed.

Method

Participants—Participants were 65 children between 22.3 and 25.6 months of age from a city in the southern US who were assigned to one of five conditions (approximately half girls and half boys in each): *live* (*M* = 24.2 months), *video* (*M* = 24.2 months), *context* (*M* = 24.2 months), *cuts* (*M* = 24.4 months), and *baseline* (*M* = 24.3 months). Data from 6 additional children were dropped from the analyses due to: refusal to play with the toys (2), researcher error (2), not returning for the second day of testing (1), and parental interference (1). In all studies reported here, potential participants were recruited through state birth records and parents were contacted by telephone. Families typically identified themselves as white (93.7%) and non-Hispanic (97.1%). Across the three studies, 3.6% of children were identified as black, 1.8% as Asian, and 0.9% as Native American. Average reported family income was in the $50,000 to $75,000 range. Parents reported that their children watched an average of 1 to 5 hours of television and videos per week, with children watching an average of less than 1 hour per week of videos designed specifically for children under the age of 3. These averages were consistent across all studies.

Materials—The stimuli in all of the studies (Figure 1) were fashioned after those used by Barr and Hayne (1999, Experiments 2 and 3) with 15- and 18-month-olds and by Hayne et al. (2003) with 24- and 30-month-olds. Both toys can be assembled in 3 steps. For the rabbit toy, the ears are raised, the eyes are placed on a Velcro strip, and the carrot is inserted in the rabbit's mouth. For the rattle, the ball is pushed through an opening in the jar lid, the handle is attached to the lid with Velcro, and the jar is shaken using the handle.

Children were seated at a child-sized table facing (1 m away) a person or a 21-inch diagonal (53 cm) color video monitor. Children in the live condition viewed a person model the sequences, whereas children in the video conditions viewed a pre-taped video of a person's demonstration played on a DVD player connected to the monitor. Children's behaviors were video recorded for later coding.

Procedure—The procedure in Study 1 was the same as that used by Barr and Hayne (1999), except that children received the demonstration and test in the laboratory rather than at home. In all conditions, there were two experimenters present at any given time. A *researcher* who was present on both days (i.e. the day of the demonstration and the day of the response) interacted with the child and parent. On the first day, in the *live* condition, a *modeler* of the 3-step sequences also was present and interacted normally with the child. In the three video conditions (*video*, *context*, *cuts*), an *assistant* was present to play the video instead of the modeler; the modeler appeared only on video to avoid the confusion of a person being present in person and on video simultaneously, and because people on television are not usually known personally by viewing children. On the second day, a *coder* recorded the children's behavior during the test. Since the live group had previously met the modeler, she was never present on day 2 in any condition. The same two people recorded the demonstration videos used in all but one video condition (another person recorded one of the two *context* videos). The three people from the videos and several others served as modelers in the *live* condition.

On the first day, after a brief warm-up with the researcher, children were seated at the table across from the modeler or the video monitor, on their parent's lap or with their parent next to them. Children in the live condition and the 3 video conditions saw a demonstration of how to assemble the toys and returned for testing 24 hours later. Children in the baseline condition did not attend the first visit and thus did not see the demonstration; they participated in the testing only. During the demonstration and test, parents were instructed not to label any of the objects or give their children any hints or help. They also were instructed not to discuss the toys with their children until after the second day of the study (see Barr & Hayne, 1999, Studies 2 and 3, and Hayne et al., 2003, for further procedural details).

Demonstration: In all conditions, the order of toy presentation was counterbalanced across participant gender and condition. Children in the *live* group received a demonstration of the 3-step toy assembly directly from the modeler. After drawing the child's attention ("Want to see some toys? Look at this."), the modeler assembled the toy, made eye contact with the child, said "okay," and then disassembled the toy. The assembly steps were always shown in the same order. This process was repeated two more times (for a total of three demonstrations) for each toy, with the modeler looking up and making a brief comment (e.g. "Let's see that again.") after each repetition. Live demonstrations averaged 2 minutes 28 seconds (*SD* = 24 seconds) in duration. Children in the *video* condition watched a prerecorded video of the same demonstration, filmed at the same table against the same backdrop (*M* = 2 min 28 seconds; *SD* = 6 seconds). Children in the *context* condition watched the same demonstration filmed in a different location (*M* = 2 min 11 seconds; *SD* = 3 seconds): Rather than sitting at the table at which the testing occurred, the modeler sat on the floor between two chairs in a different room with different carpeting and wall color than the test room.

To make the demonstration video for the *cuts* condition, cuts were introduced into the *video* condition videos to remove the disassembly of the toys. As a result, children were presented with the modeler's introductory remarks, the 3-step assembly of a toy, the modeler's look up to the camera, a 1/2 second black screen, and then the modeler's comment and assembly of the toy again. All of the speech and the 3 repetitions of the toy assembly steps remained in the video; only the toy disassembly was removed. The demonstrations lasted an average of 1 minute 34 seconds (*SD* = 6 seconds).

Testing: Children returned to the lab 24 hours later (in *baseline*, this was their first visit) and were seated at the same table. The researcher handed children the components of the toy they had seen first on day one, saying, "Look at this! Show me what you can do with this!" Children were given 60 seconds after they first touched the objects to assemble the toy. The other toy was then presented in the same way.

Scoring: In all experiments children were videotaped during both the demonstration and test. Children's *toy assembly*, as well as their *attentiveness* to the modeling, were scored in the same manner as in Barr and Hayne (1999). Two measures were used to assess children's level of imitation. First, two independent scorers, one of whom was blind to condition, observed each child's videotaped imitation behaviors for the presence or absence of the three assembly steps for each toy. Inter-rater reliability between them was high; Cohen's Kappa = .95 across all studies reported here. Disagreements were resolved through discussion. Four children were not scored from video due to equipment failures (2 from Study 1 and 2 from Study 3). In these cases, the online coder's scores were used. As a second measure of imitation, the two video coders also scored whether the steps were completed in the demonstrated order. The intraclass correlation for children's total sequencing score was .94 across all studies. Disagreements (mostly involving whether brief, ambiguous actions were present) were resolved in favor of the online coder's score.

Additionally, two independent scorers (one blind to condition) coded the amount of time children's eyes were focused on the demonstration, and calculated the proportion of total time that children were attentive. Across all studies, the intraclass correlation coefficient was .96. To assess children's comfort in the testing situation, one blind scorer examined children's latency to touch the toys across all conditions. A second scorer coded tapes for 20% of the children. The intraclass correlation was .98 across all studies. Due to equipment failures, videos from 2 children (one each from Studies 1 and 2) were not scored for attentiveness, and from 6 children (3 from Study 1 and 3 from Study 3) for latency to touch (reflected in the differing degrees of freedom reported in the results for those measures).

Results

Imitation Scores—Children's mean imitation score (0 to 3 steps) was computed for each toy. Preliminary analyses showed no significant effects of age, gender or order on imitation behaviors in any of the studies, so these were not included in further analyses. Baseline scores indicated that children did not need the demonstration to begin assembling the rattle: the children in this condition completed an average of 1.0 out of the 3 rattle behaviors, with 9 of 13 putting the ball in the jar. In contrast, baseline children completed, on average, only 0.46 of the 3 rabbit behaviors, with no more than 3 performing any given step. Because the step of putting the ball in the jar seemed obvious to the children in our sample, clear evidence of children's imitation of the demonstration could be assessed only for the other steps. Therefore, we dropped the initial rattle step from the analyses, and children received a final score out of 5 behaviors (see Figure 2).

A one-way ANOVA with imitation scores as the dependent variable yielded a main effect of group, $F(4, 60) = 15.16$, $p < .01$, $\eta_p^2 = .50$. Bonferroni post hoc comparisons revealed a significant difference between the *baseline* group scores ($M = 0.77$, $SD = 0.73$) and each of the other group's scores, p's $\leq .01$. There were no significant differences at the .05 level between any of the remaining conditions: *live* ($M = 3.69$, $SD = 1.25$), *video* ($M = 3.69$, $SD = 1.11$), *context* ($M = 3.54$, $SD = 1.20$), *cuts* ($M = 3.08$, $SD = 1.38$). An examination of individual scores revealed that most of the 13 children in each of the four modeling conditions imitated 3 or more behaviors (*live*—11 children; *video*--11 children; *context*--11 children; *cuts*--9 children) whereas none of the children in the baseline condition produced more than 2 of the behaviors.

To assess the degree to which children imitated the modeler's exact demonstration, we also calculated scores for producing the steps in sequence. Children were given one point for completing the first and second steps, and another point for completing the second and third steps, in order and with no other behaviors in between, achieving scores from 0 to 4 (2 for each toy). It was rare for children in the baseline group to produce steps in the order that was modeled for the other groups; 10 of the 13 children received a sequencing score of 0. Although children in the other conditions produced a substantial number of the individual steps that had been modeled, they produced relatively few in the modeled sequence, with the most frequent sequencing score being 1 across all groups who received a demonstration. For instance, children often put the ears of the rabbit up after completing another step rather than moving them first.

Attentiveness—Children were very attentive to both kinds of demonstration, with 47 of 51 attending more than 85% of the time (*live* $M = 96.0\%$, $SD = 4.0\%$; *video* $M = 94.7\%$, $SD = 8.9\%$, *context* $M = 93.8\%$, $SD = 6.6\%$, *cuts* $M = 92.5\%$, $SD = 8.3\%$). A univariate ANOVA with condition as a fixed factor showed that there was no significant difference in attention between these conditions or in any of the other conditions reported in Studies 2 and 3, $F(7,94) = 0.56$, $p = .79$, $\eta_p^2 = .04$.

Latency to Touch Toys—Because children in the baseline condition were tested during their sole visit to the lab, it was possible that unfamiliarity or discomfort suppressed their actions toward the toys. As a measure of children's comfort in the testing situation, we examined whether or not they were slower to touch the toys than children in the other conditions. Most of the children (84%) across all of the conditions in Studies 1, 2, and 3 touched the toys within 5 seconds. Almost all (96%) had begun to interact with the toys within 10 seconds. The remaining especially hesitant or shy children (4%) were equally distributed across

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conditions. A univariate ANOVA with condition as a fixed factor revealed no difference in latency to touch between any of the conditions reported in Studies 1, 2, and 3, $F(8,101) = .86$, $p = .56$, $\eta_p^2 = .06$.

Discussion

Contrary to our prediction and to the results of previous research, we found no significant difference between the amount of imitation displayed by children who saw the demonstration offered by a person who was present and those who saw the demonstration of a person on video. These results indicate that toddlers *can* learn simple skills from video as efficiently as they learn from a live demonstration, at least under the conditions used in this study. Relatively little sequencing—producing steps in the demonstrated order—occurred; approximately half the children produced one sequence of two steps. Many more individual behaviors were produced. We speculate about possible reasons for failure to reproduce exact sequences in the General Discussion.

Changing the backdrop context that appeared in the demonstration video did not significantly affect 24-month-old children's imitation of the target behaviors; children's encoding of information from the demonstration video was sufficient to allow the presentation of the toy components on day 2 to serve as a retrieval cue, despite the backdrop context change. This finding is consistent with results (not involving video) reported by Hayne et al. (2000) that changes in room context affected the imitation of 6-month-olds but not older infants, and with the conclusion arising from Smith and Vela's (2001) meta-analysis of context-dependent memory research (with older children and adults) that changes in room did not disrupt memory performance. Additionally, removing the toy disassembly from the video demonstration did not significantly alter children's imitation of the target behaviors. Although less information about the function of each of the pieces was provided, children's encoding and retrieval of the video demonstration supported their imitation of some of the behaviors.

Study 2

We next investigated the possibility that the *duration* of the video demonstration in Study 1 may have accounted for our participants' relatively high imitation scores. In a recently published set of studies using the rabbit and rattle stimuli, Barr and colleagues found that younger children (12 to 21 months) imitated more from videos that included more repetitions (Barr, Muentener, Garcia, et al., 2007). Infants either were shown a live demonstration of the assembly of the two toys *three* times (as in Barr & Hayne, 1999), a video demonstration of the toys *six* times, or no demonstration. Infants in the video and live conditions imitated equally well, and significantly more than infants who saw no demonstration. An additional group of 21-month-olds who saw the video demonstration only three times imitated better than children who saw no demonstration but worse than those who saw 3 live or 6 video repetitions. Therefore, double the exposure to the video resulted in imitation scores comparable to those of their live group, who received the usual amount of exposure.

In Barr, Muentener, Garcia, et al. (2007), however, both duration and number of repetitions were manipulated. The infants who saw 6 video repetitions experienced not only more repetitions but also a *longer* demonstration than did infants in their live condition (60–63 seconds, versus 36 seconds, for 3 repetitions). Our demonstrations (both live and video), by comparison, were at a slower pace, and therefore lasted longer (3 repetitions of the demonstration of the two toys took over 2 minutes).[1] The pace or duration of a video may

[1]A stimulus video we borrowed from the Hayne lab while designing our toy stimuli featured slow pacing of the demonstrated behaviors, as well as "cuts" that removed the disassembly of the toys. We later learned that the tape was from an unpublished study.

matter for young children's mental processing of an event: in recent research, 18-month-olds' ERP (event-related potential) brain responses to 2-dimensional pictures were slower than their responses to real objects (Carver, Meltzoff, & Dawson, 2006). Given the extended exposure to the slow actions in Study 1, 24-month-old children did not seem to need additional repetitions to imitate the skills from video compared to live events. However, if our video demonstration was shorter, children might not have sufficient time to form a rich mental representation of its contents that could be retrieved later. In contrast, a short (or fast) demonstration by a person who was present might be encoded more efficiently.

To test this, we exposed children to videos or live events of shorter duration. We chose to shorten our videos by including only one repetition of the toy assembly, in order to retain the pacing and verbal script of our original videos, but end up with total demonstration times close to the one-minute length used by Hayne et al. (2003). By shortening the presentations in both the live and the video conditions, we were able to avoid confounding repetition and duration. We expected that children who saw the live demonstration just once would imitate more of the behaviors than children who saw the same short demonstration on a pre-recorded video.

Method

Participants—Participants were 26 children between 23.3 and 25.6 months (*M* = 24.3 months; 13 males and 13 females). One additional child's data were dropped from analysis due to parental interference.

Materials—All of the materials and procedure were the same as in Study 1, except a new, shorter live demonstration or video was used.

Procedure

Demonstration: Children in the *1-demonstration-live* group saw a person model the 3-step toy assembly and disassembly for each toy *once* in a face-to-face interaction. The introduction, the first toy demonstration, the comment made between toys, and the conclusion were kept the same as in the full-length videos and live demonstrations from Study 1; the second and third repetition were simply removed, resulting in demonstrations lasting 1 minute 7 seconds (*SD* = 8 seconds) on average. Two of the live modelers recorded videos (averaging 1 minute 8 seconds, *SD* = 6 seconds) for the *1-demonstration video* group.

Testing and scoring: The same procedure was used.

Results

To examine whether children displayed a video deficit when exposed to shorter demonstrations, we compared imitation data from the *1-demonstration live* (M = 3.15, SD = 0.80) and *video* (M = 1.85, SD = 1.46) conditions in Study 2 (see Figure 3) using a two-tailed independent samples t-test. Children who saw the live demonstration did imitate significantly more steps than children who saw the video demonstration, $t(24) = 2.83$, $p < .01$, $d = 1.07$.

To examine the effect of length of demonstration on toddlers' imitation, we also compared data from the 1-demonstration live and video conditions from Study 2 with data from the 3-demonstration conditions from Study 1. A two-tailed t-test indicated that there was no difference in the level of children's imitation in the two *live* conditions, $t(24) = 1.31$, $p = .20$, $d = 0.50$. However, children in the 1-demonstration *video* condition imitated significantly less than those who saw the longer video in Study 1, $t(24) = 3.63$, $p < .01$, $d = 1.37$.

Individual children's levels of imitation in the *1-demonstration live* condition were similar to those of the children in Study 1. Eleven of the 13 children imitated 3 or more behaviors, and all imitated at least one behavior. In the *1-demonstration video* condition, only 4 children imitated 3 or more behaviors, and 4 did not imitate any steps.

Children who saw the short demonstrations did not reproduce the modeled *sequence* of steps; 12 of the 13 children in each condition received sequencing scores of 0 or 1. The most frequent score in both groups was 0. The single presentation of the 3-step sequence apparently was too brief for children to remember the steps in order, regardless of mode of presentation.

Discussion

Thus, the duration of the video had a significant impact. Although imitation of individual modeled behaviors remained high following the short live demonstration, imitation following the short video demonstration dropped significantly. Because the retrieval cues were the same as in Study 1 (i.e., the testing situations were identical), the difference in imitation must have been due to a difference in the quality of the memory formed from the short versus the long video.

The duration of our 1-demonstration video closely matched that of Hayne and her colleagues' (2003) 3-demonstration video. Our pattern of results, as well as our mean scores in the 1-demonstration live and video conditions, and the magnitude of difference in scores between conditions, was the same as in their studies with 24-month-olds. This suggests that *duration of exposure* may be a key to helping young children use information from video, rather than the number of repetitions, *per se*. With less time to encode the attributes of a demonstration appearing on a video screen, children's memories of the event may contain insufficient information. A future test of this hypothesis would involve manipulating the number of repetitions while keeping the duration of the demonstration constant. One application of such research would be determining the appropriate pace of human action to use in educational videos designed for very young children.[2]

Study 3

In our final study, we explored whether children's imitation from video might depend on the particular viewing situation in which the demonstration was presented. Although much of the research supporting the video deficit has been done in a laboratory setting (e.g., Troseth & DeLoache, 1998; Deocampo, 2003; Deocampo & Hudson, 2005; Suddendorf et al., 2007; McCall et al., 1977), the specific studies on which ours were based were conducted in the home (Hayne et al., 2003; Barr & Hayne, 1999) with children viewing the video demonstrations on their family television screens.

Applying the dual representation hypothesis (DeLoache, 1987, 2000), we reasoned that children might have difficulty thinking about video both as a familiar entity in their living rooms—a source of entertainment and fantasy—and as a potential source of information about something real. When presented with other types of symbolic objects having more than one function, children in earlier studies focused on the use of the object that was highlighted. For instance, after playing with a scale model as a toy for 5 minutes, 3-year-old children who would be expected to easily use it as a symbol had difficulty doing so (DeLoache, 2000). Playing with alphabet letters as toys for 2 weeks (e.g., stringing magnetic letters as jewelry and blowing bubbles with the letters "o" and "e") negatively affected 5-year-olds' demonstration of letter knowledge and understanding of the symbolic properties of letters (Uttal, Marulis, Lewis, &

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[2]Here we use "pace" to refer to the speed of human action. A separate issue in media research involves frequent changes in scene and characters (termed "pacing" in the media literature), which also may affect children's comprehension and learning from video (e.g., see Huston & Wright, 1983).

DeLoache, 2007). Therefore, children's experience with an alternative function of a symbolic object may affect their recognition of its role as a representation of something else.

The role of a video image as a representation of reality may be less than clear to children because in their experience, television bears an inconsistent relation to real events: sometimes it represents real things (even current reality—e.g., children seeing themselves on security monitors in stores), but often it does not (Troseth et al., 2004). Most of children's experience with video likely involves cartoons and other television programs that include non-real entities. Because children's experience with television happens at home, their expectations about video may have the greatest impact in that setting. Barr, Hayne, and colleagues' imitation studies, in which children consistently imitated less from video than from a live demonstration, were carried out in the home for the sake of ecological validity, with the video demonstration shown on the family TV set. Therefore, in Study 3 we visited children in their homes and presented them with our original 3-demonstration video from Study 1 or an equivalent live demonstration. We predicted that if watching their family TV highlighted the unreal, non-informational aspects of video (learned from prior television viewing in that setting), children in the video condition would be less successful than those in the live group at recalling and using the demonstration to guide their behavior when they were presented with the toy components a day later. They also might produce fewer of the modeled behaviors than the children in Study 1 who viewed the demonstration video in a viewing setting (the lab) and on a monitor that was not their usual one for watching TV.

Method

Participants—Participants were 26 children between 23.2 and 25.9 months (*M* = 24.5 months; approximately half males and females in each condition). Ten additional children were dropped for parental interference (3), parent decision not to continue (2—a set of twins), equipment failure (3), lack of cooperation (1), or failure to participate on day 2 (1).

Materials—The same materials were used. Children watched the pre-recorded video from Study 1, or received the equivalent live demonstration, in their own homes. Children in the *in-home live* condition saw the modeler in their living room; children in the *in-home video* condition saw the modeler on their home television set or (in 2 cases) on the family computer (when the stimulus DVD would not play in their DVD player connected to their TV). The families' televisions/monitors ranged from 19-inch diagonal (47 cm) to 61-inch diagonal (152 cm), with a median 26-inch diagonal (130 cm) screen—larger than the 21-inch diagonal monitor used in the lab. Half of the children stood or sat close to the screen (including those who watched on the atypically small 19-inch TV and the computers) and half sat on a couch further from their television sets. There was no significant correlation between the position from which children watched (sitting on the floor close to the screen or on a couch across the room) and their imitation score.

Procedure

Demonstration: In both conditions, children saw the same demonstration as in Study 1 (with the 3-step sequence repeated 3 times for each toy). Mean duration of the live modeling was 2 minutes 10 seconds (*SD* = 13 seconds). The full-length videos from Study 1 (which were a little longer than the live demonstrations, on average) were used for the *in-home video* condition.

Testing and scoring: The experimenters returned to the home 24 hours later. Children were seated in the same room where they had watched the video or live demonstration on the first day and tested in the normal manner. As was the case in Study 1, the researcher was present on both days but the modeler (live or video) was never present on the second day. Scoring was the same as in the other experiments.

Results

We used a two-tailed independent samples t-test to examine whether there was a “video deficit” pattern in the children’s imitation after they viewed live or video demonstrations in their homes (see Figure 4). As predicted, children who saw the in-home *live* demonstration imitated significantly more than children who saw the in-home *video* demonstration, $t(24) = 2.24$, $p = .04$, $d = 0.85$.

We also examined how children’s imitation at home compared to that of children who saw the same demonstrations in the lab in Study 1. A two-tailed *t*-test revealed that imitation scores of children in the *in-home live* condition ($M = 3.77$, $SD = 1.36$) and in the original, in-lab *live* condition were equivalent, $t(24) = 0.15$, $p = .88$, $d = 0.06$. However, the level of imitation in the *in-home video* condition ($M = 2.62$, $SD = 1.26$) was significantly lower than the level of imitation in the *video* condition from Study 1, $t(24) = 2.31$, $p = .03$, $d = 0.87$. That is, children who watched the 3-demonstration video on their home televisions imitated significantly less than children who watched the same video on the monitor in the lab.

Individual children’s imitation scores in the *in-home live* condition were similar to those of children in the original *live* condition from Study 1, with 11 of 13 children imitating 3 or more behaviors and no children receiving a score of 0. In the *in-home video* condition, only 7 children imitated 3 or more actions.

As in Studies 1 and 2, children in the in-home conditions did not often produce the steps in the modeled order. The most frequent sequencing score in both in-home conditions was 1.

Discussion

Consistent with our hypothesis, we found that the children who viewed the video demonstration in their home environment imitated significantly less than the children who saw the same video in the lab. The level of imitation from the live demonstration was high in both contexts, showing that (non-video) aspects of the home environment were not responsible for the lower levels of imitation from video in the home. If, for instance, it was easier for children to remember an event that occurred in a novel lab situation, or the home environment contained more distractions, then children in both *in-home* groups should have imitated less than the children who came to the lab. The difference in imitation from exactly the same video, shown in the lab versus in the home, suggests that children’s prior experience watching television at home played a role in how they responded to and used the information from a video image.

General Discussion

The results reported here provide further information about children’s deferred imitation of skills learned from people on video. First, the studies show that under some circumstances, 2-year-old children will imitate a person on video or a live modeler equally. In other cases, a video deficit (Anderson & Pempek, 2005) is apparent in very young children’s imitation. Consideration of the situations under which children did or did not imitate, and comparison of the requirements of imitation versus other cognitive tasks, may clarify factors involved in the early use of a symbolic medium for information.

In Study 1, 24-month-old children saw a person who was on video or present with them in a laboratory room model a sequence of behaviors. When they returned to the lab a day later, the children in both conditions reenacted those behaviors at similar high rates that were significantly above baseline. This unexpected result was different from the consistent pattern of poorer imitation from video reported in earlier research with very similar tasks (Barr & Hayne, 1999; Hayne et al., 2003). Neither changing the background against which the video was filmed, nor inserting cuts to remove the disassembly of the toys, had a significant effect on children's delayed imitation. An unfamiliar background context and the presence of cuts are two characteristics of events shown on television. These factors did not disrupt 24-month-old children's reenactment of the modeled behaviors in this study.

The perceptual similarity of the 2-dimensional video images to the real, 3-dimensional objects was sufficient for the sight of the toy components on day 2 to evoke children's memories of events involving those toys. The fact that children imitated some of the modeled behaviors indicated that they could make sense of the modeler's actions with objects that they saw on the video screen. Even babies are able to recognize objects and people depicted in 2-dimensional images (Barrera & Maurer, 1981; DeLoache, Strauss, & Maynard, 1979; Hochberg & Brooks, 1962; Slater, Rose, & Morison, 1984). In terms of Johnson's (2000) "threshold model" of object perception, the video demonstration in Study 1 provided sufficient perceptual information, and the children had sufficient perceptual skill, to allow them to interpret the 2-dimensional video images.

In Study 2, children were exposed to shorter demonstrations involving only one presentation of the toy assembly steps. Following the 1-demonstration videos, toddlers imitated only about half as many of the behaviors as the children who watched a single live demonstration, and half as many behaviors as the children who watched the longer demonstrations. Our short presentations were close to the length of those used in earlier research with the rabbit and rattle toys (Barr & Hayne, 1999; Barr, Muentener, Garcia, et al., 2007; Hayne et al., 2003). Children's level of imitation following the short video and live presentations, and the magnitude of difference between imitation scores in the two conditions, were very similar to those found by Hayne et al. (2003) with 24-month-olds. One difference between the studies was that our short presentations included *one* demonstration of the two 3-step sequences, whereas Hayne's and her colleagues' equally short demonstrations included *three* repetitions of the sequences. In both cases, there did not appear to be enough time for children of this age to encode complete and robust memories from the video that could be accessed during the test one day later.

In contrast, children's level of imitation in the current research was equally high after a short or a long demonstration with real toys, carried out by a person who was present. Children appeared to encode memories from a live event more quickly and efficiently than they did an event appearing on video. This could be related to the findings of Carver and colleagues (2006) that toddlers discriminated a favorite toy from an unfamiliar object more quickly than they did pictures of the same objects. Speaking of how these differences might play out in behavior, such as in a habituation task, Carver et al. speculate, "Perhaps when it takes infants longer to recognize something as familiar (on the order of milliseconds), that translates somehow into a less 'solid' representation, so they need more exposure time to reach 'familiarity'" (p. 60). Perhaps missing visual cues used to interpret depth (e.g., binocular disparity and motion parallax) make interpreting a picture (or video) of an object slower than identifying a real object.

Perceptual impoverishment (Barr, in press; Barr & Hayne, 1999; Barr, Muentener, Garcia, et al., 2007) therefore may contribute to young children's difficulty in imitating events seen on video, but this factor can be overcome by allowing more time to process the demonstration. The "take-home" message of Study 2 is that video designed to teach very young children must provide sufficient time for them to process and store the visual information.

The results of Study 3 indicate that the video deficit should not be attributed solely to perceptual differences between video and live stimuli. Children who were exposed to the longer video demonstration (from Study 1) on their home television set imitated significantly less than the children who participated in the lab. Something about watching the demonstration in their typical TV-viewing context made it more difficult for them to retrieve a memory of the modeled events when they were presented with the real toys a day later.

The out-of-context video condition of Study 1 suggests that the crucial difference was not the filming of the video in another context, as this factor had no effect there. The home context did not appear to be more distracting than the lab; children who watched a live demonstration in their living rooms or the lab produced equivalent imitation. What apparently mattered was that the children saw the video demonstration in their familiar TV-viewing context, which seemed to affect the memories they encoded of the objects and modeled events on their TV screen and/or the ease of retrieving these memories.

Children's developing concept about television might lead to a "video deficit" especially in this viewing context. Children as young as age two are thought to develop experience-based initial conceptions in other domains that affect their processing of information; two examples are gender schemas (e.g., Bauer, 1993; Ruble & Martin, 1998) and biases regarding word learning (Hollich, Hirsch-Pasek, Golinkoff, et al., 2000; Imai & Haryu, 2004; Saylor & Sabbagh, 2004). Similarly, 24-month-olds may conclude from their viewing experience that video is not a reliable source of information about the real world—it often contradicts what they know and does not connect with their ongoing experience. This conception of video could affect children's use of the information from the video demonstration, just as playing with the scale model as a toy affected 3-year-old children's use of the model as a source of information about the room (DeLoache, 2000).

One puzzle in the current research is that the 24-month-olds in Study 1 were equally successful at imitating from our longer (3-demonstration) videos or live events—whereas in many other lab studies, children of this age have not reliably used information from video (e.g., Deocampo, 2003; Deocampo & Hudson, 2005; Schmitt & Anderson, 2002; Troseth & DeLoache, 1998). A task analysis sheds light on the difference.

To imitate, children must encode a memory that will be accessed when they see a retrieval cue (e.g., the real toy components); they do not need to remember the source of the information. In object retrieval tasks, the demands are different on the first and later trials. On the first trial, children watch an event (a person hiding a toy), and then they are taken to the room and told to find the hidden toy. If they make sense of the video image and store a memory of the hiding event, that memory may be evoked when they are taken to the room; seeing the hiding place may serve as a memory cue, much as the toy components served as a memory cue in Study 1. In several studies, 24-month-olds have been relatively successful in finding a hidden object on trial 1 (Schmitt & Anderson, 2002; Suddendorf, 2003; Troseth, Schmidt, et al., 2006).

However, on subsequent object retrieval trials, children must choose between two memories. First, children store a memory of where they found the toy on trial 1. Watching the hiding event on the video monitor on the next trial, they may encode a memory of the toy's new location. If they do so, they will have two conflicting memories of the toy's location. To search correctly, they must *choose* the current information from video over the outdated memory from their own direct experience. However, this is something that 24-month-old children rarely do.

What helps children of this age to choose information from the symbolic medium of video over their own direct perception is prior experience with video that reliably conveys information about reality. In one study, 24-month-old children watched themselves "live" on their home television sets (which had been connected to their parents' video cameras) for an hour over the course of 2 weeks. When they came to the lab, these children were more than 3 times as successful in the search task as a control group who had played with their parents at home but had not seen live video (Troseth, 2003). In another study, the strongest predictor of 24-month-olds' use of information from the lab video monitor for correct searching was their prior experience with live video on their parents' video camera screens or on security monitors in stores (Troseth, Casey, Lawver, Walker, & Cole, 2007). Experience that emphasized the veracity and reliability of video led toddlers to choose (current) information from video over (outdated) information from their direct search of the room on earlier trials. It apparently led them to evaluate a memory from a symbol as the more relevant information.

Prior experience with *people* on video may contribute to the "video deficit". By their second birthday, children are skilled at picking up on the social information provided by people they interact with—information that may be one of their primary routes to learning about the world (Baldwin, 2000; Baldwin & Moses, 2001). Although people on television may look at the camera and appear to address the viewing child, they cannot respond contingently, providing at best a "quasi-social" experience in which "the high levels of social control that infants typically attain with their caretakers stands in marked contrast to the complete lack of direct control that infants may achieve over the 'social' stimulation produced by television" (Hollenbeck & Slaby, 1979, p. 45). Given infants' and toddlers' sensitivity to social engagement (Bigelow et al., 1996; Hains & Muir, 1996), it makes sense that they might conclude that people on TV are not potential social partners. In two independent studies, children were much more likely to follow verbal directions given by a person who was present in the room versus the same person on video (Schmidt, Crawley-Davis, & Anderson, 2007; Troseth Saylor, & Archer, 2006). However, after the person on screen responded contingently to children for 5 minutes (via a 2-way, closed circuit system), calling them by name, making apparent eye contact, playing "Simon Says", and talking about an object in the children's environment, children used the information she provided (Troseth et al., 2006). Both of these studies involved information about a toy's location that changed from trial to trial; the children who had learned to trust a person on video as a social partner followed her instructions rather than relying on their own experience (where they had previously found the toy in the room).

In another study, Nielsen and colleagues (in press) manipulated how socially engaged a modeler in an imitation task was with a viewing child. The modeled action was arbitrary and somewhat awkward (using a stick to press a switch to open a box, instead of using hands). Two-year-olds were more likely to imitate the exact behaviors of a person who was present and responsive than a person on a pre-taped video. In a follow-up study, children were more likely to imitate the exact actions of a modeler who communicated with them via a closed-circuit video system (i.e., in a contingent interaction); when the person on pre-taped video was non-responsive, toddlers were less likely to copy her exact actions (although they still attempted to achieve—by their own means—the end goals that they had observed on video). Nielsen et al. reason that social interaction affects imitation from video because children imitate, not just to learn how to do something, but also to sustain social interaction (Meltzoff & Moore, 2002; Užgiris, 1981). Exact copying is intended to communicate and forge an interpersonal bond.

Our participants did not produce many of the sequences in the modeled order in either the video *or* the live conditions. The testing situation may not have motivated exact imitation for affiliative reasons: our tests involved delayed imitation, and the person who had demonstrated the actions never was present on day 2. Also, in the demonstration the modeler followed a set script that included looks up to the child and short comments, but this did not constitute a two-way, contingent social interaction such as the one that evoked exact imitation in the Nielsen et al. (in press) study.

Because children's use of information from video involves social and conceptual factors as well as perception of similarity, age differences are to be expected. Children who have not yet developed a concept that people and objects on video are separate from reality might take information from video "at face value", as long as they have passed a perceptual "threshold" to identify objects shown in 2 dimensions (Johnson, 2000). Of interest, the youngest children that Barr and her colleagues have successfully tested with their in-home delayed imitation procedure (6-month-olds) imitated at the same rate whether the modeler was present or on video (Barr, Muentener, & Garcia, 2007). Given their extreme youth, 6-month-olds required double the demonstrations regardless of presentation mode, revealing less-efficient memories than older children (Barr, Dowden, & Hayne, 1996). The fact that the infants imitated a model on their home television suggests that they had no expectations about video that hindered their forming and accessing memories of the events.

The "video deficit" has usually been reported in older infants (Barr & Hayne, 1999) and in toddlers around their second birthday. In object retrieval tasks in the lab, 30-month-old children were much more successful than 24-month-olds at applying information from video to a real situation (Schmitt & Anderson, 2002; Troseth & DeLoache, 1998). However, in a difficult "conflict" search task, even 38-month-olds did not often use video for information (Zelazo et al., 1999). Also, children's self-recognition from a live video image lags behind their self-recognition in mirrors until their third birthday (Suddendorf et al., 2007). In *delayed* self-recognition tasks, children still had difficulty using information from video until near their fourth birthday (Povinelli et al., 1996; Suddendorf, 1999; Zelazo et al., 1999). However, giving children specific experience with the relation between video and real events overcame the video deficit in several studies, showing that the issue is not one of age, but of experience and the conclusions children draw from that experience (Skouteris et al., 2006; Troseth, 2003). Children's first concept regarding 2-dimensional images seems to differentiate such images from real objects and events; only later do they work out how such images can represent reality. As children continue to gain experience with various forms of symbolic media and symbolic activities (e.g., early drawing and writing activities), they develop further awareness of the representational functions of pictorial media. It is likely that age-related factors such as cognitive flexibility and the capacity to represent multiple relations also make it easier for children to understand and represent symbolic relations (DeLoache, 2000).

In both the current research and earlier imitation studies, it is important to note that infants and toddlers do learn *something* from video. Even when they do not learn as much as children who get direct modeling, children who receive video instruction often do better than those in the baseline group who received no demonstration (e.g., in the current research and in some age groups in Barr & Hayne, 1999; Hayne et al., 2003; Barr, Muentener, Garcia, et al., 2007). Children can learn important skills by imitating. For instance, popular programs such as *Dora the Explorer* encourage the preschool audience to imitate educationally relevant strategies modeled by a character on screen, such as making a list, planning, asking for help, or consulting a map.

To the extent that a video mimics social interaction (by using a conversational give-and-take pattern, leaving pauses for the child's response, etc.), *preschoolers* are more likely to learn from an on-screen person (Anderson, Bryant, Wilder, Santomero, Williams, & Crawley, 2000). Whether *toddlers* also learn from "interactive" programs such as *Blue's Clues* and *Dora the Explorer* remains an important topic of future research (see Linebarger & Walker, 2005). Given a rich/poor achievement gap that follows children throughout the school years (Princiotta, Flanagan, & Germino Hausken, 2006), and the fact that toddlers from a wide range of socioeconomic backgrounds in industrialized countries have access to television, discovering factors that enhance early learning from video is surely a worthwhile endeavor.

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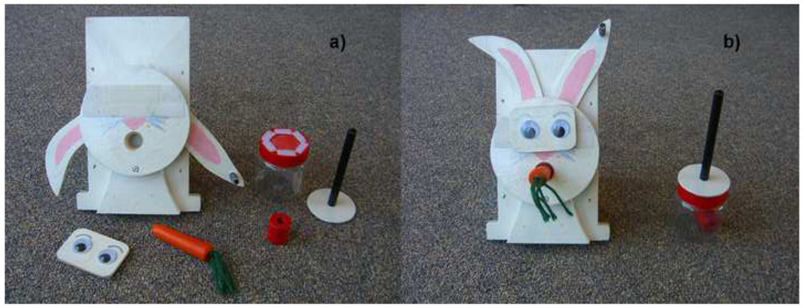

Figure 1.
Rabbit and rattle stimulus toys used in Studies 1, 2, and 3 a) disassembled, and b) assembled.

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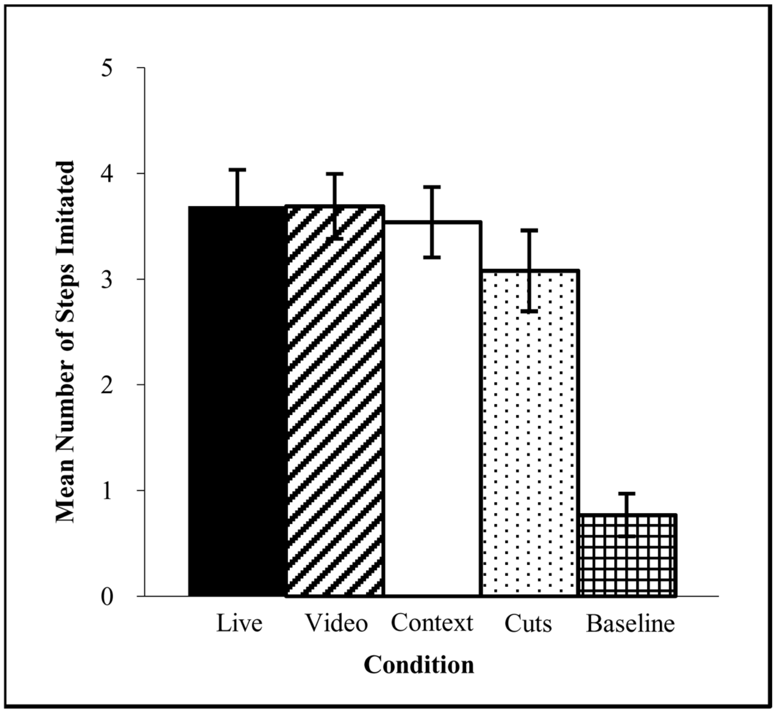

Figure 2.
Mean number of assembly steps (+*SE*) completed (out of 5) in the *live, video, context, cuts,* and *baseline* conditions in Study 1.

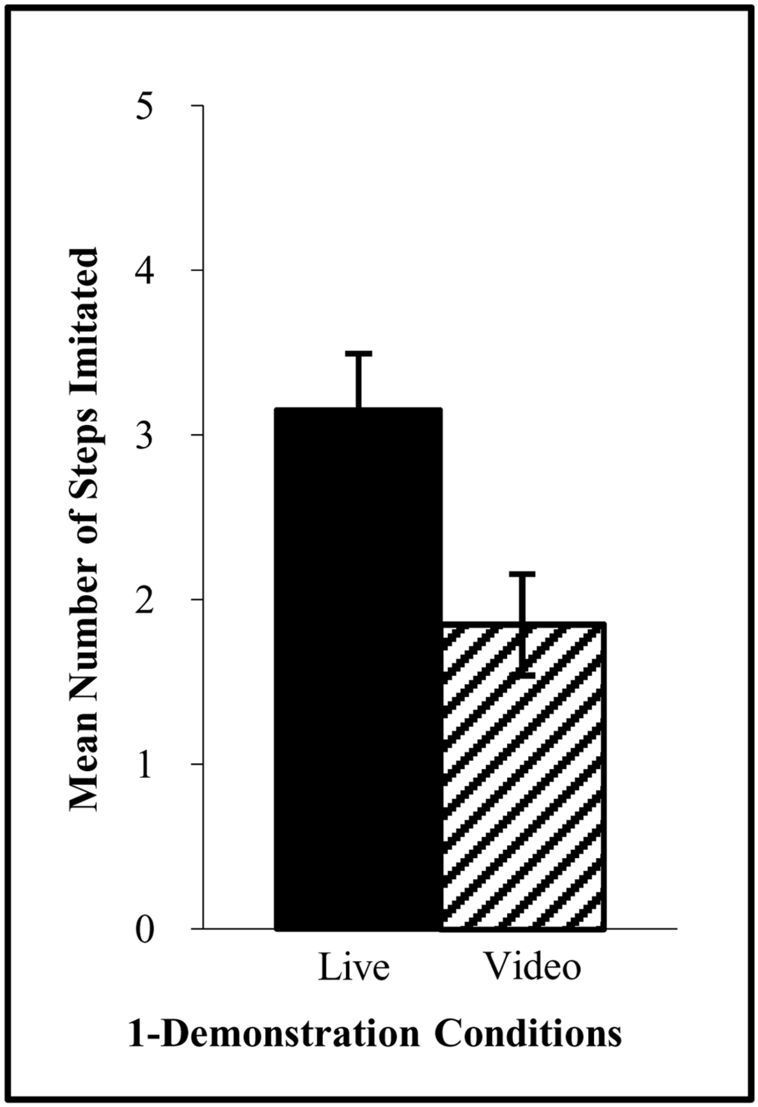

Figure 3.
Mean number of assembly steps (+*SE*) completed (out of 5) in the *1-demonstration live* and *1-demonstration video* conditions of Study 2.

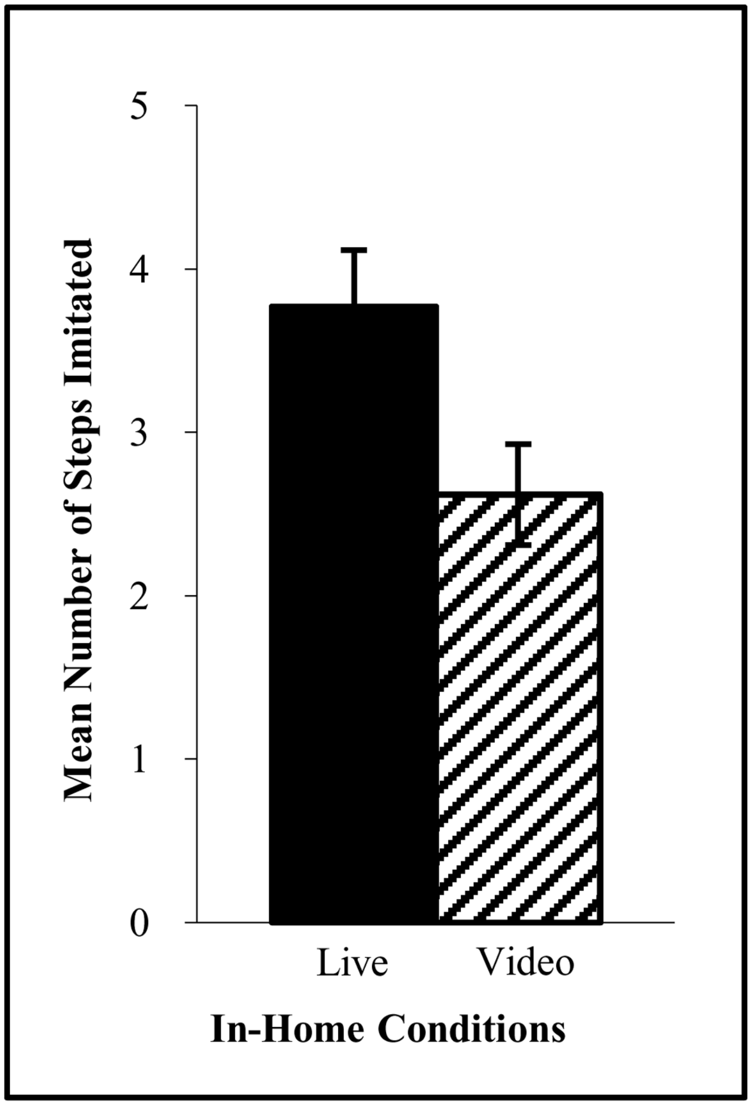

Figure 4.
Mean number of assembly steps (+*SE*) completed (out of 5) in the *in-home live* and *in-home video* conditions of Study 3.