Two-year-olds' object retrieval based on television.

TWO-YEAR-OLDS' OBJECT RETRIEVAL BASED ON TELEVISION

A Thesis Presented

by

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ABSTRACT

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Previous studies have revealed that 2-year-olds have great difficulty using information from television to find a real object hidden in a room. Here we tested a perceptually based hypothesis for their poor performance by reducing the perceptual differences between the television image and the hiding space. The perceptual hypothesis focused on the difficulty of forming a representation of the 3-D hiding space shown on video. Two-year-olds were asked to retrieve a sticker hidden on a felt board after watching an experimenter hide the sticker either on the same felt board, on an identical felt board, or on television. Only those 2-year-olds who saw the experimenter hide the sticker on the same felt board could find it. This result indicates that reducing the perceptual discrepancies between television and the reality of the hiding space (the felt board) did not eliminate 2-year-olds' difficulties finding the hidden object. When Trial 1 data was analyzed separately, however, children who saw the sticker hidden on television were above chance, suggesting that 2-year-olds may have some ability to use information from television to find a hidden object. Overall, the research confirms earlier studies, which suggest that young children have great difficulty using a highly iconic medium to guide their behavior in object retrieval tasks.

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CHAPTER 1

INTRODUCTION

Two-year-olds have difficulty finding a hidden object when the location of the object is conveyed on television (Crawley, 2001; Schmitt & Anderson, in press; Troseth & DeLoache, 1998). Although 2-year-olds sustain attention to television programs, differentiate comprehensible and incomprehensible TV content, and imitate simple actions seen on television, they have difficulty using information from television to retrieve a real object (Anderson, Lorch, Field, & Sanders, 1981; Meltzoff, 1998; Schmitt, 1993).

Schmitt and Anderson (in press) propose that this difficulty occurs because perceptual information on television is degraded compared to information presented live. Troseth and DeLoache (1998) propose an alternative explanation. Their theory states 2-year-olds do not understand that television can represent reality and believe that nothing on television is real. This study tests Schmitt and Anderson's theory. Specifically, it measures whether 2-year-olds can use television to find a hidden object when the hiding space is 2-dimensional and the same size as the television screen.

Literature Review

Several areas of the literature pertain to the present study. Research about 2-year-olds' TV viewing will be considered first, followed by research that addresses young children's ability to imitate what they have seen on television. Literature on young children's ability to use representations formed from media will be presented last.

Attention to Television

Preschoolers watch several hours of television each day (Huston, Wright, Rice, Kerkman, & St. Peters, 1990). In a reanalysis of videotapes collected by Anderson et al. (1985), Schmitt (1995) found that, by 2 or 3 years of age, children looked at the television more than a third of the time (when they were with a set in use), compared to very low levels of looking at 6 months of age and about two thirds of the time at 5 years of age (Anderson et al, 1986). Two-year-olds also looked more at child than adult programming (Schmitt, 1995). Studies by Anderson and his colleagues have revealed that attention to television is guided by perceived comprehensibility of television content, suggesting that 2-year-olds do comprehend some television (Anderson & Smith, 1984). When segments of Sesame Street were made less comprehensible (by randomizing shots or substituting backwards or foreign dialogue), 2-year-olds looked more at normal segments than at reduced comprehensibility segments (Anderson, Lorch, Field, & Sanders, 1981).

Observing 3-to 24-month old infants, Richards and his colleagues found that children did not distinguish a meaningful television stimulus from randomly moving shapes and computer-generated sounds until 18 months of age (Richards & Cronise, 2000; Richards & Gibson, 1997). Attention to the two stimuli did not differ for 3-to 12-month old infants; in contrast, for infants 18 months of age and older, looking was greater and the child's heart rate slower (indicating engaged attention), when the television stimulus was meaningful. A picture of the 2-year-old television viewer, based on the attention literature, thus emerges: 24-month-olds prefer comprehensible television stimuli and, likely as a consequence, pay more attention to children's programming. Schmitt, Anderson, and Collins (1999) verified this latter point in home observations.

Perception of the Reality of TV

Although 2-year-olds do understand some television content, the extent of their understanding is not apparent. In particular, it is not clear how they conceptualize the relationship between television and reality. Jaglom and Gardner (1981), in a longitudinal field study, analyzed the associations three children (from age 2 to 5) made between television and real life experience. They found that the children, at 2 years of age, could not clearly indicate how events and objects that appear both on television and in daily life were related. Although they displayed some awareness that what they saw on television might not occur in real life, they were most likely, at 2 years, to make associations classified as overgeneralizations. As defined by Jaglom and Gardner, overgeneralizations indicated that the children thought events on television could directly influence them, and that they could, in turn, directly influence events on television. According to Jaglom and Gardner, "if an egg breaks on television, they run to get a paper towel to clean it up, and they have trouble falling asleep because they believe the monster seen on television is in their room. The glass screen separating the television from the real world is forgotten"(Jaglom & Gardner, 1981, p. 24). 2-year-olds lacked a clear understanding of the boundaries between television and reality.

By age 3, the children made few overgeneralizations. At 3 years of age, they recognized that some aspects of television and reality were similar, but they did not think that the two worlds could affect each other. At age 4, the children started to make associations classified as overdifferentiations, indicating that they believed nothing on television was real. For instance, "a child seeing himself and his father on television says that neither of them are real people because they are on television" (Jaglom & Gardner,

1981, p. 25). By age 5, the children's understanding of the relationship between television and reality had changed, so that the 5-year-olds could realize that some televised events occur in real life, while some do not, and that similarities *and* differences exist between television and reality.

In a series of studies, Flavell and his colleagues (1990) tested whether 3- and 4-year-olds think of television images as real, solid objects located inside the set, or as representations of objects. In Study 1, 3- and 4-year-olds viewed four videotapes of both static and dynamic images, including a balloon, a bowl of popcorn, a moving horse, and ocean waves. After each video presentation, two types of questions were asked. "Reality" questions tested whether children thought the video images were real objects or pictures of objects, e.g. "Is the balloon real or a picture?" "Affordance" questions asked children whether they could act on the objects, or whether the objects themselves could act, e.g. "If the television is turned upside down, would the popcorn fall out?" In Study 2, 3-year-olds were administered control questions with corrective feedback, followed by questions similar to those in Study 1. Each child participated in three tasks, each with three subtasks, (real, photo, and video). The video subtask was always last, with the real and photo tasks preceding it (in counterbalanced order). During each task, the experimenter asked the child what would happen after he or she acted on each stimulus, including a solid object, a photo (of the object), or a TV set (depicting an image of the real object). Thus, the child was asked, for each subtask, " If I turn this (object, picture, TV set) upside down, will the X come out?" Corrective feedback was provided after the real and photo subtasks, so that, by the video subtask, children had been shown that real objects and photographs do not "act" the same. Study 3 replicated Study 2, except that the questions

were not asked hypothetically. Instead, the experimenter performed an action behind a screen, and the child was asked to describe what had happened.

While 4-year-olds did not interpret television images as real objects, answering the questions correctly 87-88.9 % of the time (in Study 1), 3-year-olds' interpretation of TV images was considerably less easy to define (Flavell et. al., 1990). Across the three studies, 80 % of 3-year-olds answered four of the six object "affordance" questions correctly. Although few correct responses were made in Study 1 (only 41 % answered the "affordance" questions correctly), performance was significantly better in Study 3, where training and feedback were provided. Noting that a large minority of 3-year-old children, in studies 2 and 3, did not correctly answer the photo and video questions (saying, for instance, that water would spill out when a picture of a filled glass was turned upside down), Flavell and his colleagues speculated that young children have trouble thinking of TV images as representations. Flavell and his colleagues concluded that, while most 3-year-olds don't explicitly believe that solid objects reside in the TV set, they do not think of television images as depictions of real objects, either. Citing Jaglom and Gardner (1981), Flavell and his colleagues supposed, however, that 2-year-olds, in contrast to 3-year-olds, do believe that they are viewing tangible objects, residing on or in the television set.

Other researchers have investigated young children's beliefs about the reality of familiar television programs. As part of a study of preschool-age children's television viewing, Lyle and Hoffman (1972) asked 3-, 4- and 5-year-olds, "Where do the people and kids and things on your TV go when your TV is turned off?" Only 20 % of the

children seemed to understand the question; these were mostly the older children, although most of them still failed to respond correctly.

Hawkins (1977) asked children in preschool and grade school (first, third, and sixth graders) a series of questions about whether television characters are real or actors. He found that belief in the reality of television decreased with age (Hawkins, 1977).

Nikken and Peters (1988) examined the responses of preschoolers (4 to 6-year-olds) and second graders (7 to 9-year-olds) to twenty questions about the reality of two segments of Sesame Street. Three types of questions were asked. The first ten questions focused on the content of the segments, such as "A child from another school told me that [a character] is a puppet with a hand inside. Is that true?" The next five questions assessed whether the children thought they could interact with characters from the show; such as "If [a character] is on television, and we talk to her, can she understand us then?" The last five questions were about the location of characters on television, including "Is [character] in the television now?" Using factor analytic procedures, Nikken and Peters differentiated the following three dimensions of television reality: the television show really exists (i.e. whether or not it is staged, or whether the characters are actors), characters on television can communicate with viewers, and objects and people on television reside in the set. For 4 to 6-year-olds, age strongly correlated with belief in all three dimensions, whereas for 7 to 9-year-olds, age did not predict belief in any of them. Nikken and Peters concluded children's perception of the reality of television changes with age. Preschoolers are more likely than older children to believe characters on television are real people in the set (Nikken & Peters, 1988).

Wright and his colleagues (1994) investigated how children develop the ability to distinguish between reality and unreality on television. Five and 7-year-old children responded to questions about the reality of their favorite television shows. They were also asked a series of similar questions about pairs of test clips of factual and fictional programs. Each pair was matched for type of content. Although most of the children thought their favorite shows were not real, the 5-year-olds were less likely to believe the programs were rehearsed, or that the characters were playing roles. Whereas 5-year-olds were more likely to think all the television programs were not real, 7-year-olds used program cues to distinguish factual content (like news) from fictional content. In an attempt to determine whether understanding of television reality is largely determined by cognitive development or experience, Wright and his colleagues administered the Peabody Picture Vocabulary Test to the children and asked parents to complete 1-week television viewing diaries once every six months for two years (Wright, Huston, Reitz, & Piemyat, 1994). While age and vocabulary test scores predicted whether children accurately judged the reality of television programs, TV viewing experience did not. Wright and his colleagues concluded cognitive developmental factors, rather than experiential ones, determine when children understand television reality (Wright et al., 1994).

To summarize, preschoolers do not clearly understand the relationship between television and reality. Previous research suggests that young children think characters on television are real people in the set with whom they can communicate (Lyle & Hoffman, 1972; Nikken & Peters, 1988). Studies also suggest preschoolers think objects on TV retain the properties of real objects (Flavell et al., 1990; Jaglom & Gardner, 1981). With

age, children think of television as less real (Hawkins, 1977; Jaglom & Gardner, 1981). However, even older children (5 to 7-year-olds) have difficulty understanding that television characters are actors performing a rehearsed script (Wright et. al., 1994). Cognitive developmental factors appear to be most influential in determining whether children understand television reality (Wright et. al., 1994).

Imitation of Televised Models

Meltzoff (1988) observed infants' ability to imitate what they see on television. After a 24-hour delay, 14-and 24-month-old infants could reenact simple behaviors that they saw performed on television, using novel objects. The children watched the experimenter, on television, pull a dumbbell-shaped object apart and put it back together again; they were, in fact, able to imitate this action. From this study, Meltzoff concluded that 14- and 24-month-old infants could use a 2-dimensional image to guide their own actions in 3- dimensional space. However, Barr and Hayne (1999) found that 12- and 15-month-old-infants, after a 24-hour delay, could not imitate multiple-unit actions displayed on television. In contrast, they could imitate a live presentation of the same action. The children watched as a videotaped or live model removed a puppet's right mitten, shook the mitten (ringing a bell inside) and replaced the mitten. Only 18-month-old infants could imitate the video model after a 24-hour delay; all age groups could imitate the live model. However, when 15-month-olds were tested on a simpler action presented on television, they were able to imitate it (at a level similar to that after seeing a live model) immediately after viewing the presentation. In addition, McCall, Parke, & Kavanaugh (1977) demonstrated that 18- and 24-month old infants imitated a television model significantly less often, and less accurately, than a live model. Thirty-six-month-olds, in

contrast, did not respond differently to the two demonstrations (McCall, Parke & Kavanaugh, 1977). Taken together, these studies suggest children younger than two have more difficulty imitating a television presentation than a live one, except when the behavior is extremely simple.

In a study with older children, Bandura, Ross, and Ross (1963) observed that 35- to 69-month-olds imitated a physically aggressive human model on film as much as a live human model. In three experimental groups, children observed a model performing aggressive actions on a Bobo doll. The model was a live human model, a human model on film, or an animated character on film. Children in the control group were not exposed to a model. After being exposed to the aggressive display, the children's aggressive actions (both imitative and non-imitative) were recorded, in a separate room, which contained both aggressive and non-aggressive toys. Prior to entering the experimental room, the children were frustrated (the experimenter allowed the children to play with toys, and then told them they could not play with those toys, because they were reserved for other children). Children who observed a physically aggressive model (live, human on television, or animated on television) demonstrated twice as much aggression as children who did not observe a model. Although there were significant differences in the amount of aggression exhibited by children who observed the real-life model versus the animated model, the children who observed the human model on television did not exhibit a significantly different amount of aggression from either of the other two experimental groups. However, the children who observed the human model on television did play aggressively with guns (one of the toys provided in the experimental room) significantly more than children who observed a real-life model. Thus, children

older than two imitate a human model on film as much as a real-life human model. An animated model on film, however, is not imitated as much as a real-life human model, perhaps because the animated model is less real. As Bandura and his colleagues explain, "it was predicted on the basis of saliency and similarity of cues, that the more remote the model was from reality, the weaker would be the tendency for the subjects to imitate the behavior of the model" (Bandura, Ross, & Ross, 1963, p. 3).

Symbol-use Difficulties in Young Children

Judy DeLoache's research has demonstrated young children's difficulties using symbols to locate hidden objects. In a series of studies, young children (2.5 and 3-year-olds) were encouraged to find a toy behind an item of furniture in a room when the location of the toy was conveyed through a demonstration with a scale model. Thus they did not observe the hiding event directly; instead, they watched the experimenter hide a miniature toy in a scale model of the room. Before they were asked to search in the room (containing large versions of the same objects found in the model), each child participated in an extensive orientation, during which the experimenter explicitly pointed out the correspondence between the two spaces. In addition, the children were told that the two toys, e.g. a Big and Little Snoopy, like to do the same things. After searching in the large room, each child returned to the model to retrieve the small toy from it (DeLoache, 1999). The second retrieval tested the child's memory of the original hiding event; if he or she successfully retrieved the small toy from the model, failure to retrieve the large toy from the room could not be attributed to forgetting where it was hidden in the model. Each child typically participated in four hiding and retrieval trials.

In DeLoache's original study, 3-year-olds retrieved the hidden toy without error 77 % of the time. 2.5-year-olds, in sharp contrast, retrieved the hidden toy without error only 15 % of the time (DeLoache, 1987). Numerous studies have confirmed DeLoache's initial results. In general, 3-year-olds' rate of errorless retrieval averages between 75 and 90 %, while 2.5-year-olds' rate of errorless retrieval averages about 20 % (at chance) (DeLoache, 1999). For both age groups, however, performance on the memory-based retrieval averages between 75 and 95 % (DeLoache, 1999).

Success on the standard model task requires that young children mentally represent several relations (DeLoache, 1999). First, for each trial, they must represent the relation between the small toy and its hiding place in the model. This representation must be stored in memory, so that it can be accessed at retrieval. Second, there must be a representation of the relation between the model and the large room. Using this representation, the child must form a third, of the large toy in its hiding place in the room (DeLoache, 1999). Thus, the child must use a constructed mental representation to infer the location of the large toy. This, in fact, is what DeLoache claims 2.5-year-old children cannot do; although they are able to represent the relation between the small toy and the model, they cannot use it to construct a representation of where the large toy is hidden. That is, they don't seem to understand that the model and the room are related.

Despite 2.5-year-old's difficulty with the standard model room task, they are clearly able to use symbols. They use language, and they participate in symbolic play (DeLoache, 1999). If the size disparity between the model and the room is reduced (so that the room is twice as big as the model), 2.5 year olds are more successful at the model room task (Deloache et. al, 1991; DeLoache, 1999; Marzolf & DeLoache, 1994).

DeLoache concludes that 2.5 year olds are, thus, able to use scale models for object retrieval; however, the task is difficult enough that they are only successful under specific, facilitative conditions (DeLoache, 1999).

Young children's difficulty with the standard model room task has been attributed, in part, to the problem of dual representation. According to DeLoache's dual representation hypothesis, it is difficult for young children to represent an object as salient and interesting in itself, as well as a symbol for something else. As she states (DeLoache, 1999, p. 71), it is "particularly difficult for young, inexperienced symbol users to 'see through' a scale model…to its referent." In support of the dual representation hypothesis, DeLoache has demonstrated that making the model more salient as a three- dimensional, real object decreases children's performance on the model room task. When 3-year-old children were told to play with the model for up to 10 minutes preceding the task, their performance dropped significantly (from 80 to 40 % errorless retrievals) (DeLoache, 1999). When the model was made less salient as a real object, by placing it behind glass, 2.5-year-olds' performance was better, increasing from 20 to 50 % errorless retrievals (DeLoache, 1999). Furthermore, the dual representation hypothesis predicts 2.5-year-olds successful performance on object retrieval tasks using pictures or television, since 2-dimensional objects are less interesting in themselves (DeLoache, 1999).

Providing further support for the dual representation hypothesis, DeLoache has shown that young children, if led to believe that the model *is* the room, perform much better than they do in the standard model room task. By convincing children that a "shrinking machine" had shrunk the room into the model, DeLoache tested how children

would perform on a task that did not require them to represent the model as both an object in itself and as a symbol of the room. When dual representation was not necessary, 2.5-year-olds were successful at the model room task, achieving a rate of 76 % errorless retrievals (DeLoache, 1999; DeLoache, Miller & Rosengren, 1997). In another series of studies, DeLoache and Burns (1994) demonstrated that 2-year-old children did not succeed on an object retrieval task when the object's location was conveyed through a photograph. According to DeLoache and Burns, the children did not think of the pictures as providing useful information about current reality.

Troseth and DeLoache's Research and Theory

Although 2-year-olds can imitate simple actions presented on video, they cannot consistently retrieve hidden objects based on information from television. A series of studies by Troseth and DeLoache have measured whether or not young children can use information presented on video to find a hidden toy (Troseth & DeLoache, 1998). They found that 2-year-olds, in contrast to 2.5-year-olds, had difficulty finding an object in a test room after watching the hiding event on television, achieving a modest 44 % errorless retrievals, or trials on which the children found the toy in the first place they searched without any prompts. However, if 2-year-olds watched the hiding event through a window, they were, in fact, able to retrieve the object, at a rate of 100 % errorless retrievals. When 2-year-olds were told they were looking through a window, but they were actually watching television, their performance improved (to 63% errorless retrievals), but it was still worse than in the actual window condition. Note that Troseth and DeLoache (1998) gave each subject four trials; they did not indicate whether performance varied as a function of trial.

Troseth and DeLoache (1998) claim that 2-year- olds do not realize that television can represent a current reality existing someplace else, and, thus, think that nothing on television is real. By this account, 2-year-olds have learned that television is a source of entertainment, that it does not affect them directly, and that the objects and events on television are "pretend." (DeLoache, 1999). According to Troseth and DeLoache, children do not expect television to provide them with useful information about reality.

Schmitt and Anderson's Research and Theory

In an independently conceived study, Schmitt and Anderson (in press) found similar results to Troseth and DeLoache. Like Troseth and DeLoache, they found that 2-year-olds had great difficulty finding a toy when they watched the hiding event on television (25 % errorless retrievals). However, they found that 2.5-year-olds also had difficulty finding the toy after the video presentation (56 % errorless retrievals compared to 79% in Troseth & DeLoache), and, when search time was measured, even 3-year-olds had difficulty with this task. Additionally, Schmitt and Anderson found a trial effect for 2- year-olds in the video condition. Whereas they were above chance in object retrieval on the first trial (60 % correct), their performance dropped on subsequent trials. Their most common mistakes, in those trials, were perseveration errors, defined as going to the location where the toy was hidden on the previous trial.

Schmitt and Anderson (in press) propose an alternative explanation for children's performance on the object retrieval by video task, based on the role of visual perception in guiding action. First, Schmitt and Anderson (in press) hypothesize that the television stimulus is degraded, compared to reality, in that it is 2-dimensional and lacks important depth cues. Because of the degraded nature of the television stimulus, it is harder for

young children to encode information relevant to the search task. Second, based on the research to date, Schmitt and Anderson (in press) suspect that 2-year-olds think that real, three-dimensional objects reside within the television cabinet, behind the screen. 2-year-olds' perception of television, then, may induce them to think that they are seeing "real" small objects in the small space behind the screen. As a result, they may have to "scale up" their representation of the room (which is based on the television image), making the task more difficult. In fact, Troseth and DeLoache's finding that 2-year-olds in the video window condition (who were told they were looking through a window) were better at retrieval relative to the standard video condition, but not as good as in the standard window condition, bolsters this claim. In that condition, the children did not have to "scale up" the representation because they did not see the cabinet behind the TV screen. If 2-year-olds don't see the cabinet, they don't define the space behind the screen as necessarily being "small."

Third, Schmitt and Anderson (in press) hypothesize that 2-year-old's tendency to make perseverative errors overwhelms their ability to use information derived from a poorly encoded stimulus. Object retrieval based on information from television is a cognitively demanding task for young children. After the first trial, they must contend with a competing representation derived from their most recent experience in the test room. This rich representation, derived from experience in the test room, may interfere with their ability to navigate through three-dimensional space in order to find the toy.

Finally, Schmitt and Anderson (in press) point out that young children may have difficulty coordinating their allocentric and egocentric representations of the test room. Allocentric space is objective space defined by the relationship of objects in space to one

another, and egocentric space is space defined relative to the viewer's body position. An egocentric representation is, in a sense, a computation of a scene's affordances; it conveys information about the opportunities for action that a space provides. In the brain, two independent cortical streams, the ventral stream and the dorsal stream, serve separate functions in guiding actions (Milner & Gooddale, 1995). While the ventral stream forms perceptual and cognitive representations, which contain the enduring characteristics of objects, the dorsal stream captures the egocentric features of objects. Young children's egocentric representation of objects on television, based on their notion that they reside within the set, is of small, reachable, graspable objects—not of a space navigable by one's own body. In order to succeed, they would have to rely on their weaker allocentric representation, ignoring their egocentric one. This would, in fact, be nearly impossible for young children.

Present Research

The present thesis is that, by reducing the perceptual demands inherent in the video-room study, children can overcome the difficulties posed by television in an object retrieval task. A felt board retrieval task was used. This task, by eliminating many of the perceptual differences between television and reality, tested the hypothesis that 2-year-olds think nothing on television is real. First, since the felt board is already 2-dimensional, its representation was degraded very little when viewed on television. Second, the felt board and the television display were the same size, so that the child did not have to scale up his or her allocentric representation, derived from small images on television. Third, since the child didn't have to move from a topographical representation

to a projective one, (in fact, their body position hardly changed at all), their egocentric representation could be employed in both settings.

2-year-olds participated in one of 3 conditions. In all conditions, they searched for a sticker on a target felt board. Children in the 1 felt board condition saw the sticker being directly hidden on the target felt board. Children in the 2 felt board condition saw the sticker being hidden on another felt board in a box with a clear plastic front. Children in the television condition saw where the sticker was hidden via closed-circuit television.

The 1 felt board and television conditions were designed to be similar to the window and television conditions in Troseth and DeLoache (1998) and Schmitt and Anderson (in press). The 2 felt board condition was designed to test the hypothesis that children do poorly on object retrieval from television tasks because they think nothing on television is real. If this is the primary source of children's difficulty, they would be expected to do well in the 2 felt board condition, in which the second felt board is clearly real. Furthermore, the box with the second felt board inside was intended to simulate TV, or to serve as the functional equivalent of a television set. If 2-year-olds, as the literature suggests (Flavell et al, 1990; Jaglom & Gardner, 1981; Nikken & Peters, 1988), think of objects on television as real objects inside the set, they would be expected to perform equivalently in the 2 felt board and television conditions.

Schmitt and Anderson would predict strong performance in all of the conditions, since the perceptual differences between television and reality would have been significantly reduced. Troseth and DeLoache would predict poor performance in the television condition compared to the 1 felt board condition, since children would, over all four trials, think nothing on television was real. The 2-year-olds in the television

condition would also fail to see television as a representation of current reality, accounting for their predicted poor performance in this condition, according to Troseth and DeLoache's theory.

CHAPTER 2

METHOD

Design

Two-year-old children were randomly assigned to one of three conditions: "1 felt board," "2 felt board," or "Television." The children in the 1 felt board group watched the experimenter hide a sticker on a felt board and were asked to retrieve the sticker from the same felt board. The children in the 2 felt board group watched the experimenter hide a sticker on a felt board and were asked to retrieve an identical sticker from an identical felt board. The children in the television group watched the experimenter on closed-circuit television hide a sticker on a felt board and were asked to retrieve the sticker from an identical felt board. The overall design was a Conditions (3: 1 felt board; 2 felt board; or Television) X Sex (2) between subject design.

Participants

Fifty 2-year-old children, (range 708 days to 763 days; mean age was 729 days) were randomly assigned to one of the three conditions. There were 8 boys and 9 girls in the 1 felt board condition, 8 boys and 8 girls in the 2 felt board condition, and 8 boys and 9 girls in the television condition. Four additional children were dropped from the data analysis (two because of experimenter error, one because of equipment failure, and two because of fussiness) and replaced. Children were recruited from state birth records via a letter and a follow up telephone call.

Setting and Apparatus

The study was conducted at the Child Study Center, a four-room suite located in a professional building in downtown Springfield, Massachusetts. One room (14' X 12.5') was required for testing.

Floor to ceiling curtains, extending from one end of the room, lengthwise, to the other, divided the test room into two rectangular spaces. A table (6.5' X 2.5') was placed, also lengthwise, in the center of the room; the table's back edge rested against the curtains. Another table was placed behind the curtains and was not visible to the participants. A floor to ceiling curtain was made to hang along the front edge of this table, extending half the table's length (about 3').

Two identical, rectangular felt boards (31.5 cm X 37 cm) were used in the study. Black borders were placed around the edges of the felt boards in order to make the hiding space on each the same size as the television screen. Four felt hiding objects, representing a balloon (6 cm X 4.5 cm), two different-colored gift-wrapped boxes (7.5 cm X 4.5 cm, and 5 cm X 4.5 cm), and a birthday cake (5 cm X 7.5 cm) rested on each board. These constituted the hiding places. A small, teddy bear sticker (1.5 cm X 1.5 cm) was used as the hiding object.

In the 1 felt board condition, one felt board and an easel were required for testing. In the 2-felt board condition, two felt boards and one easel were used. In addition, a rectangular box (41 X 41 X 78 cm) with a clear plexiglass front, wooden sides, and no back was constructed for the 2 felt board condition. The box was designed so that the felt board could rest upright between two grooves on its base. A small black and white video

monitor was used in the 1 and 2 felt board conditions. A 13-inch color television set and 2 felt boards were used in the television condition.

Two video cameras were required. A video camera, which was placed behind the curtains, was used to record the hiding event in the television condition. While the experimenter was hiding the sticker, the children watched a live feed from this video camera to the television set. Another camera, placed against the front wall of the room, facing the front of the curtains, was used to record the children's reaching for the felt board.

Procedure

Each experimental session began with a brief warm up, allowing the experimenters to play with the child and to obtain parental consent. During the warm up, parents also completed a Television Viewing Questionnaire (Appendix). Once consent was obtained, the child moved into the testing room, where he or she sat on the parent's lap in front of the table. The parent sat in a swivel chair, and he or she was told to move slightly during the study, in order to orient the child towards the appropriate felt board.

An orientation followed, during which Experimenter 1 familiarized the child with the felt board. She pointed out all four hiding places and the sticker, saying "We're going to play a hiding game. This is my felt board, and all these things are on it. (Experimenter 2) likes to hide this teddy bear [sticker] on the felt board." For each felt object, she placed the sticker behind it, saying "Sometimes she hides him here," and then removed the felt object, displaying the sticker underneath.

Children in the 2 felt board condition also participated in a correspondence training. The experimenter showed the child both felt boards, saying about the felt board

in the box, "This is my special box. It has a felt board inside it just like that one. See, it looks the same as this felt board." For each felt object, the experimenter pointed to it on the felt board in the box and asked the child to point to it on the other felt board, saying "I'm touching this one. Can you touch this one on that felt board?"

The children in the television condition participated in a video correspondence training. The child sat in front of the television set, and Experimenter 2 pointed out the correspondence between the video display and the felt board. She said " This is my special TV that shows my felt board. Look, its my felt board on TV!" To ensure that the child was aware of the correspondence, the experimenter asked the child to touch the felt object that she pointed to on television. She said, "I'm touching this one. Can you touch this one on that felt board?" This continued for each of the four locations. For each object, the child was encouraged to keep trying until the correct object was touched.

Once training was complete, each child was encouraged to participate in four test trials. For each trial, Experimenter 2 hid the object in one of the four different locations. The hiding places occurred in balanced order, so that each of the hiding places was first for 2 boys and 2 girls in each condition. In the 2 felt board condition, one of the hiding pieces was first for 3, rather than 2, boys, due to experimenter error. For the following three trials, the order was randomly selected without replacement from six possible orders. When the six orders had been used, for the remaining 2 children, two orders were randomly chosen without replacement.

At the beginning of each trial, the experimenter showed the child a bear sticker. In the 1 felt board condition, the child was told that he or she was going to help find the sticker but that first Experimenter 2 would show them where to look for it. As

Experimenter 2 walked behind the curtain, Experimenter 1 said, "Now (Experimenter 2) is going to go behind the curtain. There she goes. She's going to hide the teddy bear sticker, and we're going to watch her."

In the 2 felt board condition, Experimenter 1 said " (Experimenter 2) is going to go behind the curtain. She's going to hide the sticker, but we're not going to watch her. She's going to show us where she hid it." In the television condition, the child was told that he or she was going to help find the sticker, but that first they were going to watch TV, which would tell them where to look for it. Experimenter 1 said, "Now (Experimenter 2) is going to go behind the curtain. There she goes. She's going to hide the teddy bear sticker, and we're going to watch her on television."

In the 1 felt board and 2 felt board conditions, Experimenter 2's hands emerged from behind the curtains; the children did not see her face during the hiding part of the test trial. The camera that was located against the back wall, which recorded the child's reaching, was also connected to a small video monitor on a shelf behind the curtains. The live feed from this camera could be viewed by the second experimenter, which allowed her to hide the sticker on the felt board from behind the curtains without the child seeing her face.

In the television condition, a closed circuit video segment showed the second experimenter's hands hiding the sticker on the felt board. This view closely approximated what the child saw in the 2 felt board condition. The felt board covered the entire screen, and the felt objects on screen were the same size as the real felt objects. To the extent possible, the video display of the felt board was the same size as the actual (test) felt board.

Experimenter 1 followed an identical script in all of the conditions, which described the hiding event as it occurred. When the second experimenter's hands emerged from behind the curtain, or on the video screen, the first experimenter said, "Look, (Experimenter 2) is hiding the bear now. Look where she's hiding it…Remember where it is." The location was not labeled.

After the hiding event, each child was encouraged to search for the sticker on the felt board. In the 1 felt board condition, Experimenter 2 hid the sticker on the test felt board, which was located on the left side of the table. The child was allowed to search as soon as the sticker had been hidden. Between trials, Experimenter 1 covered the test felt board with the curtain.

In the 2 felt board condition, Experimenter 2 hid the sticker on the felt board in the box, which was located on the right side of the table. As in the 1 felt board condition, the test felt board was placed on the left side of the table. A short delay between trials allowed Experimenter 2 to hide the sticker on the test felt board prior to test. During the hiding event, Experimenter 1 covered it with the curtain. After Experimenter 2 hid the sticker on the felt board in the box, the curtain was pulled back from the test felt board, and the child was immediately allowed to search. While the child searched, Experimenter 2 held black construction paper against the plexiglass front of the box, so that the child could not look back at the felt board inside it.

In the television condition, Experimenter 2 hid the sticker on closed circuit television. The television set was located on the right side of the table. The test felt board was in the same place, on the left side of the table, as in the 1 and 2 felt board conditions. During the hiding event, Experimenter 1 covered it with the curtain. Immediately after

Experimenter 2 hid the sticker, the television was turned off and Experimenter 1 pulled back the curtain.

In all conditions, the first experimenter said, "Find the teddy bear on this felt board," and pointed to the felt board on which the sticker was hidden. If the child's first attempt was not successful, the experimenter said to the child "Try a different place," until the child found the sticker. One prompt, "It's in the same place that [she] hid it on [TV, that felt board]" was used after the first unsuccessful search. Between trials, the front curtain was lowered in front of the felt board for several seconds. Each child's behavior during the correspondence training and while searching for the sticker was recorded by a video camera on a tripod.

Coding

Two independent observers scored the videotapes recorded during the study. In order to determine inter-rater reliability, both observers scored 43 of 50 tapes. The remaining 7 did not have a videotape record due to equipment failure. The coder first recorded if the child's first try was successful. A successful retrieval was defined as removing the appropriate felt object from the felt board to find the sticker. If the first attempt was not successful, the coder indicated the subsequent number of attempts required to find the sticker. Coders also indicated when the child made perseverative errors (he or she went to the location where the toy was hidden on the previous trial).

A percentage agreement was determined to assess coder agreement on whether or not the child searched correctly on each trial, the location of searches, and the number of perservative errors. For each of these variables, the number of trials on which the coders agreed were divided by the total number of trials (on which the variable was observed)

times 100. Inter-rater reliability (r) averaged .98 for whether the child's first reach was successful and for the location of their reaches. For whether the child perseverated on trials 2 through 4, inter-reliability averaged .93.

CHAPTER 3

RESULTS

Errorless Retrievals

As can be seen in Figure 1, the percentage of errorless retrievals was higher in the 1 felt board condition (82 %) than in either the 2 felt board condition (33 %) or the television condition (30 %). A 2 (sex) X 3 (Presentation Condition) ANOVA revealed a significant main effect of condition, F (2, 44) = 25.76, $p < .001$. There was a marginally significant gender by condition interaction, F (2, 44) = 3.00, $p = .06$. Girls performed slightly better than boys in the 1 felt board condition, and boys performed slightly better than girls in the 2 felt board condition.

Since gender had only a marginal effect on performance, the data were collapsed over this variable in subsequent analyses. Post hoc pairwise comparisons (Bonferroni procedure) revealed that the percentage of errorless retrievals in the 1 felt board condition was significantly different from the percentage of errorless retrievals in the 2 felt board condition, t (1, 44) = 35.15, $p < .001$, and the television conditions, t (1, 44) = 41.5, $p < .001$. Percentage of errorless retrievals in the 2 felt board condition did not differ significantly from percentage of errorless retrievals in the television condition.

Trial 1

Both theory and previous research have revealed that Trial 1 performance is the most uncontaminated test of 2-year-olds' performance on this task. On Trials 2 through 4, perseverative errors may interfere with performance; on Trial 1 there is no opportunity for this kind of error.

A chi-square test was run on Trial 1 performance. The overall test revealed a significant effect of condition, $\chi^2(2) = 6.19$, $p < .05$. As displayed in Figure 2, in the 1 felt board condition, 70 % of the children correctly searched on the first trial, compared to 27 % of children in the 2 felt board condition. One child was not included in the analysis for the 2 felt board condition because her first trial data was not codeable. In the television condition, 53 % of children searched correctly on the first trial (see Figure 2). Pairwise comparisons, using Fisher's exact test, indicated that the number of children with errorless retrievals on the first trial in the 1 felt board condition was significantly different from the number of children with errorless retrievals on the first trial in the 2 felt board condition, $p < .05$. The number of children with errorless retrievals on the first trial in the television condition, while intermediate in performance, did not differ significantly from the number of children with first trial errorless retrievals in either the 1 felt board or the 2 felt board conditions. Binomial tests revealed that first trial performance was significantly above chance (25 %) in the 1 felt board condition, $p < .001$, and in the television condition, $p < .01$.

Trials 2,3,4

The mean percentage of errorless retrievals on Trials 2, 3, and 4 was separately calculated (see Figure 2, for comparison with Trial 1 data). A sex (2) by Condition (3) ANOVA revealed a significant effect of condition, $F(2, 44) = 32.21$, $p < .001$. There was a significant gender by condition interaction, $F(2, 44) = 3.91$, $p < .05$. On trials 2, 3 and 4, girls had a higher percentage of errorless retrievals (100 %) than boys (71 %) in the 1 felt board condition, but they had a lower percentage of errorless retrievals (29 %) than boys (38 %) in the 2 felt board condition and in the television condition (girls, 14 %;

boys, 29 %). Since gender effects were not predicted in any of the hypotheses, and are not of theoretical concern here, the data were collapsed over this variable for the post hoc tests. In the 1 felt board condition, the mean percentage of errorless retrievals on Trials 2 through 4 was 85 %, compared to 33 % in the 2 felt board condition, and 25 % in the television condition. Although there was a significant difference between the 1 felt board group and the 2 felt board ($t(1, 44) = 37.26$, $p < .001$) and television ($t(1, 44) = 56.88$, $p < .001$) groups, the latter two groups did not differ significantly from each other.

Trial Effects

In order to test for the presence of trial effects, binomial tests were run on first trial performance by condition, using the mean percentage of errorless retrievals on Trials 2 through 4 (for that condition) as the null hypothesis probability of a correct response on Trial 1. If Trial 1 performance was significantly greater than this probability, a first trial effect was implied. The first trial performance in the television condition was significantly different from the mean percentage of errorless retrievals on Trials 2 through 4 in that condition, $p < .01$. This was taken as evidence of a first trial effect for the television condition. In neither of the remaining conditions was the first trial effect significant. A Cochran's Q test on the percentage of errorless retrievals by trial, however, revealed no significant trial effects in any of the conditions. Since there were no theoretical or empirical reasons to distinguish between trials 2 through 4, the primary theoretical interest in this study was the difference in performance between trial one and

all other trials. The binomial test was considered a more powerful test of a first trial effect than the Cochran's-Q. [1]

Perseveration Errors

Performance on trials 2 to 4 may have been low because children were making perseverative errors. A perseverative error was recorded each time a child searched for the sticker first in the location where it had been hidden on the previous trial. As can be seen in Figure 3, analysis of the percentage of perseverative errors out of total errors on Trials 2 to 4 revealed that 55 % of errors in the 2 felt board condition and 53 % of errors in the television condition were perseverative. None of the errors in the 1 felt board condition were perseverative errors. When subject to t tests, the percentage of perseverative errors in the 2 felt board condition differed significantly from chance (.33), $t\ (15) = 2.16$, $p < .05$, as did the percentage of perseverative errors in the television condition, $t\ (16) = 2.27$, $p < .05$.

Rate of self-correction was determined by dividing the number of errors that were followed by a correct response on the next reach by the total number of errors. As displayed in Figure 4, forty-seven percent of perseverative errors were self-corrected in the 2 felt board condition, compared to 26 % of non-perseverative errors. Fifty percent of perseverative errors were self-corrected in the television condition, compared to 14 % of non-perseverative errors. Only the percentage of self-corrected non-perseverative errors in the television condition (14 %) differed significantly from chance (33 %),

[1] One child in the television condition retrieved correctly on the first trial, but did not complete all four trials and was dropped from the Cochran's Q test for that condition.

t (12) = -3.04, p = .01. When subject to t-tests, there was an overall significant difference, for the 2 felt board and television conditions combined, between the rate of self-correction after perseverative versus non-perseverative errors, t (12) = 2.40, $p < .05$. For the television condition, there was a marginally significant difference between the rate of self-correction after perseverative versus non-perseverative errors, t (9) = 2.09, p = .06.

Amount of Television Viewing

In order to determine if the participants' television viewing influenced their performance on this task, each parent was asked to fill out a Television Viewing Questionnaire (Appendix). Parents indicated how many hours per week their child watched television. The percentage of errorless retrievals and the hours of television viewed per week were slightly negatively correlated, r (15) = -.34. For comparison purposes, there was almost no correlation between the percentage of errorless retrievals and the hours of TV viewed per week in the 1 felt board condition, r (14) = .06. The correlation between the percentage of errorless retrievals and the hours of TV viewed per week in the 2 felt board condition was slightly negative, r (15) = -.24. None of the correlations differed significantly from chance.

Experience with Home Video

In order to determine if the participants' frequency of viewing home videos was related to their performance on this task, parents were asked, on the Television Viewing Questionnaire (Appendix), to indicate how often their child was exposed to home videos. The children in each condition were divided into 2 groups, comprised of those children who rarely or never saw themselves on home video, and those who occasionally or

frequently saw themselves on home video. In the television condition, children who rarely or never saw themselves on home video had a rate of 31 % errorless retrievals, compared to a rate of 28 % errorless retrievals for those whom occasionally, or frequently saw themselves on home video. For comparison purposes, the percentages of errorless retrievals in the 1 felt board and 2 felt board conditions, by amount of home video viewing, are presented in Table 1. None of the differences were significant by t-tests.

CHAPTER 4

DISCUSSION

Previous studies have revealed that 2-year-olds have great difficulty retrieving a hidden object from an adjacent room when the location of the object is conveyed on television (Schmitt & Anderson, in press; Troseth & DeLoache, 1998). Schmitt and Anderson suggested that very young children have perceptual-motor difficulties mapping the television image onto the 3-dimensional space of the adjacent room.

The present study tested this hypothesis by greatly reducing the perceptual differences between the TV image and the space in which the object was hidden. Specifically, 2-year-olds searched for a sticker on a felt board after watching an experimenter hide the sticker either on the same felt board, on an identical felt board, or on closed-circuit television. A felt board was used as the hiding space so that the 2-dimensional TV image represented a 2-dimensional search space. Two-year-olds' percentage of errorless retrievals was compared across the three conditions. When Trial 1 performance was analyzed separately, eliminating perseverative errors, the 1 felt board condition was superior to the 2 felt board condition. Performance in the television condition was intermediate and not significantly different from the other two conditions. When Trials 2 through 4 were analyzed separately, the 1 felt board condition was superior to the other two conditions, which did not differ from each other, primarily because performance in the TV condition significantly declined after the first trial. A discussion of these findings follows.

Evaluation of Theories

Table 2 summarizes theory-based predictions of 2-year-olds' performance in the present study. Although none of the theories fully accounted for the pattern of results in this study, Troseth and Deloache's theory, in so far as it describes 2-year-olds' difficulty with object retrieval from television tasks as representational in nature, made the most accurate predictions. Schmitt and Anderson's theory, that 2-year-olds perform poorly on object retrieval tasks because television is perceptually different from reality, was not supported.

Schmitt and Anderson's Theory

According to Schmitt and Anderson's theory, 2-year-old children have difficulty using information from television to find hidden objects because 3-dimensional information presented on television is distorted compared to information presented live. First, Schmitt and Anderson hypothesize that it is difficult for 2-year-olds to encode 3-dimensional information from TV because of perceptual degradation, in depth cues and others, on video. Second, because visual information on television is bounded by the television set, it looks smaller than it does in real life. Schmitt and Anderson argue that 2-year-olds have to rescale their representation of information on television in order to make it consistent with reality. Finally, Schmitt and Anderson contend that 2-year-olds have great difficulty coordinating their allocentric and egocentric representations of the hiding space. All of these difficulties place an information processing burden on the child, reducing encoding and performance on the retrieval task.

Schmitt and Anderson's theory would predict that 2-year-olds should be able to find a sticker hidden on a TV sized felt board after seeing the hiding event on television because the image of the felt board is not degraded much on video. In the present study, the felt board and objects were the same size live and on television, and the display was 2-dimensional in both. Because the apparent and real sizes of the objects were the same, representations of retrieval behaviors should have been the same, making the children's allocentric and egocentric representations more concordant. Thus, Schmitt and Anderson would predict that 2-year-olds should perform equally well in all three conditions. More specifically, Schmitt and Anderson argue that 2-year-old children perceive objects and events on television as existing or occurring in the set. A felt board in a box with a clear front should, according to Schmitt and Anderson's theory, be comparable to a television display of a felt board. Schmitt and Anderson's theory would not predict a trial effect in the television condition, because once the perceptual differences between television and reality are reduced, they would expect children to do equally well on all trials. Since Schmitt and Anderson do not hypothesize that 2-year-olds have difficulties in understanding that a display can iconically represent reality, they would predict that performance in the television condition would be high, matching that of the 1 felt board condition.

The results of this study do not support the main tenet of Schmitt and Anderson's theory insofar as overall performance in the 2 felt board and TV conditions was poor. Contrary to Schmitt and Anderson's predictions, 2-year-olds' difficulty using information from television does not appear to be perceptual-motor in nature.

Troseth and DeLoache's Theory

According to this theory, 2-year-olds cannot use information from television for two primary reasons. First, Troseth and DeLoache argue that 2-year-olds have difficulty using symbols as a source of information about their referents. In particular, 2-year-olds fail to see the room on TV as a representation of current reality. Second, Troseth and DeLoache contend that 2-year-olds think nothing on television is real because of their prior experience with television. Thus, 2-year-olds should do poorly in the television condition because they think that the felt board on television is not real and not relevant to current reality. Troseth and DeLoache would not expect trial effects in the television condition since children would, over all four trials, believe that nothing on television is real. Troseth and DeLoache's theory does not make clear predictions about the 2 felt board condition.

Troseth and DeLoache would also predict that 2-year-olds who watch more television should have worse performance in the television condition, since it is 2-year-olds' experience with television that leads them to believe that TV is not real. Finally, Troseth and DeLoache would predict 2-year-olds who frequently see themselves on home video would perform better than 2-year-olds who rarely or never see themselves on home video.

The central prediction of Troseth & DeLoache's theory was confirmed. Over four trials, 2-year-olds successfully retrieved the sticker in the 1 felt board condition but not in the 2 felt board condition or the television conditions. The implication is that 2-year-olds have difficulty using information from television because they do not consider television a representation of current reality or, more generally, have difficulty using any

iconic medium as a representation of current reality. Troseth and DeLoache's theory does not account for superior performance found on Trial 1 in the television condition.

This study did not resolve whether 2-year-olds think of television as real or not real. Even when the iconic source of information was clearly real, as in the 2 felt board condition, 2-year-olds did not find the hidden object. It should be noted that trial one performance was significantly above chance in the television condition but not in the 2 felt board condition. If TV is rejected as not "real," then performance in the television condition should, if anything, be poorer than the 2 felt board condition.

In sum, Troseth and DeLoache's theory accurately predicted the main effect of this study. Two-year-olds had difficulty using information from television to find a hidden object. However, Troseth and DeLoache's theory did not accurately predict better first trial performance relative to Trials 2 through 4 in the television condition.

Evaluation of Findings

The Difficulty of Multiple Representations

This study supports the idea that 2-year-olds have great difficulty using a highly iconic medium as a source of information to guide behavior in a specified real situation. When the location of a hidden object was iconically conveyed, as in the 2 felt board and television conditions, 2-year-olds did not, by and large, successfully retrieve the object. Two-year-olds were successful in the 1 felt board condition because no symbolic awareness was required. The children did not have to infer anything from an iconic presentation. The direct and strong representation formed from watching the experimenter hide the sticker on the test felt board was the only representation required for successful retrieval.

In contrast to the 1 felt board condition, at least two representations had to be maintained in the 2 felt board and television conditions. First, the child had to encode the hiding event and the location of the object on either the identical felt board or television. Second, a representation of the location of the hidden object in the test space had to be constructed from the hiding event. Previous research has demonstrated that very young children have great difficulty using a symbol, such as a scale model or picture, as a source of information about its referent, precisely because they fail to recognize that the symbol and its referent are related (DeLoache, 1989a). DeLoache has attributed young children's difficulty on symbolic reasoning tasks to their lack of representational flexibility, or "the ability to represent, to think about, one and the same thing in two different ways" (DeLoache, 1989, p. 32). This is likely the primary source of 2-year-olds' difficulty using information from television. As explained by Troseth and DeLoache's theory, they simply fail to securely grasp that the experimenter intends the visual information on television to stand for current reality.

Although performance in both the 2 felt board and television conditions was poor relative to the 1 felt board condition, Trial 1 data strongly suggests 2-year-olds are more successful at object retrieval when the information is conveyed on television (55 % correct) as compared to an identical felt board (26 % correct). In the 2 felt board condition, performance on Trial 1 did not differ significantly from chance, whereas it was significantly above chance in the television condition.

In Troseth and DeLoache (1998), first trial data were not reported. Crawley (2001) obtained their data and found a marginal first trial effect for the television condition, with Trial 1 performance significantly better than chance. Schmitt and

Anderson (in press) found a similar trial effect in the television condition, as did Crawley (2001). The results of these three studies, as well as this one, strongly suggest that 2-year-olds are somewhat better, following a television presentation, at retrieving hidden objects on the first trial than on later trials. This implies that at least some 2-year-olds are able to use a representation from television to guide their retrieval.

This first trial effect is best explained by DeLoache's dual representation hypothesis. DeLoache's theory of dual representation states that it is very hard for young children to simultaneously interpret an object as a symbol and as a thing in and of itself. The theory also contends that the more salient the symbol, the harder it is for young children to see it as a representation of something else (DeLoache, 1989a). In support of this theory, 2.5-year-olds are more able to access information from a 2-dimensional television image or photograph than from a 3-dimensional scale model. Two-dimensional media, like photographs or TV, are not very salient as things in and of themselves (DeLoache & Burns, 1994; Troseth & DeLoache, 1998). Troseth and DeLoache originally predicted that 2-year-olds would be able to find a hidden object using information from television because video doesn't require dual representation (Troseth and DeLoache, 1998). When 2-year-olds did not succeed on the TV task, compared to the window condition, they modified their theory to state that 2-year-olds think nothing on TV is real and claimed that this was the reason children could not use television as a representation of current reality. However, by not discovering the trial effect in their own data, they failed to realize that 2-year-olds do have a very limited ability to use information from television. It is also important to note that 2-year-olds retrieved successfully 44 % of the time (across four trials) in Troseth and DeLoache's original

study. Although 2-year-olds performed worse than 30-month-olds (79 % errorless retrievals), both age groups were significantly above chance, again suggesting that 2-year-olds have some recognition that TV can provide useful information about the location of a hidden object.

Because TV is 2-dimensional and less salient as a real object, Troseth and DeLoache's original hypothesis about video is, to a certain extent, exonerated. Some 2-year-olds were able to form a fragile conceptual representation of the location of the hidden object, as evidenced by their superior performance on Trial 1. However, 2-year-olds' symbolic abilities are still quite limited, and the weak representation they formed from television was easily overwhelmed by perseverative error on subsequent trials.

Perseverative responding was common in both the 2 felt board and television conditions. Sharon and DeLoache (submitted) have suggested, based on the results of several studies with young children, that perseveration is the most common error response in search tasks (Daehler, Lonardo, & Bukatko, 1979; DeLoache & Brown, 1983; Horn & Myers, 1978). While some researchers believe that perseveration reflects a difficulty inhibiting prior motor responses (Diamond, 1985; 1991), others suggest that children perseverate because they can't inhibit a prior representation (Jacques et. al., 1991).

Although perseveration was common, children often corrected themselves in the 2 felt board and television conditions. Fifty-percent of the perseverative errors made by 2-year-olds in the television condition were self-corrected, as were 47-percent of the errors in the 2 felt board condition. Sharon and DeLoache (submitted) have used high rate of self-correction as well as variation across trials, including a first trial effect, as possible

indicators that perseverative responding may be causing poor-performance. In a reanalysis of data from several model-room studies, they found that 30-month-olds rarely corrected themselves (8 % of the time) in the standard version of the model room task, in which the room is 4 times larger than the model. In the similar scale task (the room is 2 times larger than the model), which has been shown to be much easier, 30-month-olds frequently corrected themselves (24 % of the time), and on retrieval tasks, in which they typically succeed, the rate of self correction was even higher (43 to 47 % self-correction). The high rate of self-correction in the 2 felt board and television conditions in this study strongly suggests 2-year-olds knew something about the location of the hidden sticker. However, the extent of their knowledge was masked by their tendency to perseverate. Troseth and DeLoache (1998) considered this possibility in their study, but they dismissed it because the rate of self-correction was only 25 %. Recall that 2-year-olds in the present study self-corrected twice as often. The immediacy of the target felt board may have increased the amount of perseverative error, which could have inhibited 2-year-olds' performance in the 2 felt board and television conditions.

The trial effect in the television condition provides further evidence that perseveration was causing poor performance. However, there was no first trial effect in the 2 felt board condition. Because the felt board in the box (in the 2 felt board condition) was clearly real, 2-year-olds may have formed a strong expectation that the sticker was to be found on the felt board in the box, not on the other felt board. This was evident in pilot testing of earlier versions of the task, where the felt board was not enclosed in a box. The children, convinced that the object was on the original felt board, would try to find it there, even if it required them to move a physical barrier, such as a

curtain or a large piece of plexiglass. Thus, the salience of the felt board facilitated the formation of a response representation rather than a symbolic one. That is, 2-year-olds represented the location of the sticker in the 2 felt board condition as an accessible real space, whereas in the television condition the location of the sticker was not accessible and most likely not represented as such.

It is particularly difficult for young children to overcome a strong expectation in order to choose an alternative one (Zelazo, 1999). To clarify, when very young children are required to choose from among multiple representations in order to solve a problem, the most salient representation will be adopted (Zelazo, 1999). Several studies have revealed that young children have great difficulty retrieving a hidden object when they have to choose from among conflicting alternatives. In Povinelli, Landau, & Perilloux (1996), 2-, 3-, and 4-year-olds had a sticker placed on their head during a game. The children did not know about the sticker. After several minutes, they watched a video of the game, showing the sticker being placed on their head. None of the 2-year-olds reached up to the sticker, compared to 25 percent of the 3-year-olds and 75 percent of the 4-year-olds. In a similar study using Polaroid photographs instead of video, equivalent results were found. However, when the children who did not try to touch the sticker looked in the mirror, nearly all of them reached up to touch the sticker (Povinelli, Landau, & Perilloux, 1996). According to Povinelli and his colleagues (1996), the younger children in the study did not understand representations. In particular, they lacked "a more general ability to cope with multiple, simultaneous representations of the same object or event" (Povinelli et. al., 1996, p. 1553). Thinking they could not be in two places at the same time, the children did not interpret their image on TV as a

representation of self. In fact, many of the younger 3-year-olds referred to themselves on TV or in a photograph in the third person. Povinelli and his colleagues also suggested that the younger children had difficulty because it was "a situation of conflicting representations, and they may simply defer to what they currently believe to be true" (Povinelli et. al, 1996, p. 1553). They thought of themselves in one way (no sticker), but the video presented them differently (sticker). Lacking representational insight, the children acted on the stronger representation, which was their understanding of self based on direct experience.

In a similar study, Zelazo, Somerville, and Nichols (1999) tested whether 3- and 4-year-olds could use external representations that conflicted with what they expected. Half of the children first watched an experimenter hide an object in a room. After the hiding event, they were told the object would be in a different place, and were then either told or shown (on video) where the object was located. The other half of the children did not first see the object being hidden; they were either told or shown the location of the object, with no conflicting information provided. Three-year-olds in the first group, where the verbal or video information conflicted with the hiding event they had previously seen, often could not find the hidden object. Even though they were told that the object would be in a different place, younger children did not choose the location they had been told about or seen when it conflicted with their direct experience. According to Zelazo and his colleagues, 3-year-olds may not be able to use a higher order rule to select from among multiple representations. Lacking this ability, they default to the most salient representation.

Applying these ideas to the 2 felt board condition, the 2-year-olds had a strong expectation that the sticker was on the felt board in the box, which competed with their ability to form a symbolic representation of the correct location of the sticker on the test felt board. As in the television condition, perseverative responding in the 2 felt board condition was very common on Trials 2 through 4. Two-year-olds in this condition had to inhibit representations formed from their most recent experience with the test felt board, as well as the strong expectation that the sticker was on the felt board in the box. In the television condition, the felt board on TV was not a solid object like the felt board in the box, so 2-year-olds did not have a strong expectation, on Trial 1, that the sticker was on a felt board inside the TV. Lacking this strong conflicting expectation on Trial 1, the majority of children in the television condition were able to choose the correct location on this trial only.

Do Two-Year-Olds Dismiss Television as not Real?

Recall that Troseth and DeLoache argued that 2-year-olds, based on experience with television, dismiss it as relevant to reality. Consequently, aside from any representational difficulties 2-year-olds might have, they would not use information from TV because it is not "real." However, trial one performance was above chance in the television condition. Performance in the 2 felt board condition (which was patently a "real" situation) was at chance, suggesting the representational nature of television rather than its reality status makes the object retrieval task cognitively demanding for young children.

Experience with Television and Video

The lack of a significant relationship between exposure to television and performance in this study makes it unlikely that experience with television (the suggested source of the belief that television is not real) is a primary factor in whether children are able to use it as a representation of reality. However, it should be noted that the correlation, $r = -.37$, was in the direction predicted by Troseth and DeLoache. In addition, Georgene Troseth and her colleagues found that, when children had extensive experience watching themselves on video at home for 2 weeks prior to testing, performance on the object retrieval using information from television task dramatically improved (Troseth, Rozak, & Spry, 1999).

Future Research

Future research might address whether 2.5-year-olds could succeed in the television and 2 felt board conditions in this study. This would allow further exploration of the differences between the 2 felt board and television conditions. Based on the results of previous studies, 2.5-year-olds would be expected to succeed in the television condition, but there is no precedent for the 2 felt board condition. The results of this study, however, would predict superior performance in the television condition, since the children in this condition would not form a strong, conflicting expectation of the sticker's location, as they do in the 2-felt-board condition.

Two-year-olds in this study did slightly worse in the television condition (30 % errorless retrievals) than 2-year-olds in Troseth and DeLoache's study (44 % errorless retrievals), which used a room as the hiding space. These results suggest that using a television image of a felt board to find a sticker on a felt board of the same size is at least

as, or potentially more, difficult than finding an object in a room using a television image of the room. In a modification of the model room task, DeLoache found task performance was better when the hiding spaces were identical compared to highly similar spaces (DeLoache, 1989a). However, memory based retrieval performance, which usually is high despite poor performance in the transfer task, also declined substantially. In fact, DeLoache stated the identical spaces study was the only model study that she has conducted where the percentage of errorless retrievals was less than 80 % on the memory task (DeLoache, 1989a). Suggesting that identicality may disorient children, she contended that differences in scale may be necessary for young children to see the relationship between two spaces as analogical. Testing 2.5-year-olds in the television and 2-felt-board conditions would help determine which task is more difficult for young children, thus revealing whether a search task with identical spaces is more challenging than a search task with highly similar but different-sized spaces.

Two-year-olds' performance in the 2 felt board condition, compared to the television condition, raises another interesting question for future research. If the children were asked to retrieve the sticker from the felt board in the box, I hypothesize they would search correctly, based on the strength of their representation formed from direct perception of the hiding event. Based on the results of this study, successful retrieval would be expected, at least on Trial 1, if the 2-felt-board condition was modified as follows. Rather than asking the child to find the sticker on another identical felt board, the experimenter could pull the felt board out of the box and ask the child to retrieve it from that felt board. Two-year-olds would be expected to successfully retrieve the sticker

if they did not have to infer its location from an iconic presentation, that is, from its location on the other felt board.

The implications of the findings from this study for children's media production are not entirely clear. Although 2-year-olds in this study watched about 10 hours of TV per week, they were not able to use information from television to find a sticker hidden on a felt board. However, 2-year-olds, in this study, were asked to use TV in a very unconventional way. They are rarely, if ever, asked, in their daily lives, to use specific information from television in a problem-solving task. Two-year-olds may be able to learn vocabulary or other information from television, but they most likely cannot apply specific information from TV, in an analogue representational manner, to their own lives. Although 2-year-olds would not necessarily benefit (in terms of an object retrieval task) from increased time spent viewing television, they may benefit from explicit training designed to help them see a relationship between television and reality (Troseth, Rozak, & Spry, 1999). However, it is most likely cognitive developmental maturation with age that makes information on television more applicable to children's immediate experience.

Table 1: Percentage of Errorless Retrievals by Home Video Viewing

Condition	Infrequent Home Video Viewing	Frequent Home Video Viewing
1 Felt Board	77 % (11 of 17)	91 % (6 of 17)
2 Felt Board	39 % (8 of 17)	27 % (9 of 17)
Television	28 % (8 of 16)	31 % (8 of 16)

Table 2: Summary of predictions from theories of children's difficulty using information from television to guide behavior

Troseth and DeLoache's Theory	Schmitt and Anderson's Theory
High percentage of errorless retrievals in the 1 felt board condition Low percentage of errorless retrievals in the television condition	High percentage of errorless retrievals in the 1 felt board condition High percentage of errorless retrievals in the television condition
No clear predictions about the 2 felt board condition	Equivalent percentage of errorless retrievals in the 2 felt board condition and the television condition
No trial effects in any of the conditions	No predictions about trial effects
Negative relationship between the number of hours spent watching television and percentage of errorless retrievals in the television condition	No significant relationship between the number of hours spent watching television and percentage of errorless retrievals in the television condition
Positive relationship between frequency of home video viewing and percentage of errorless retrievals in the television condition	No significant relationship between frequency of viewing home videos and percentage of errorless retrievals in the television condition

Figure 1: Performance on All 4 Trials

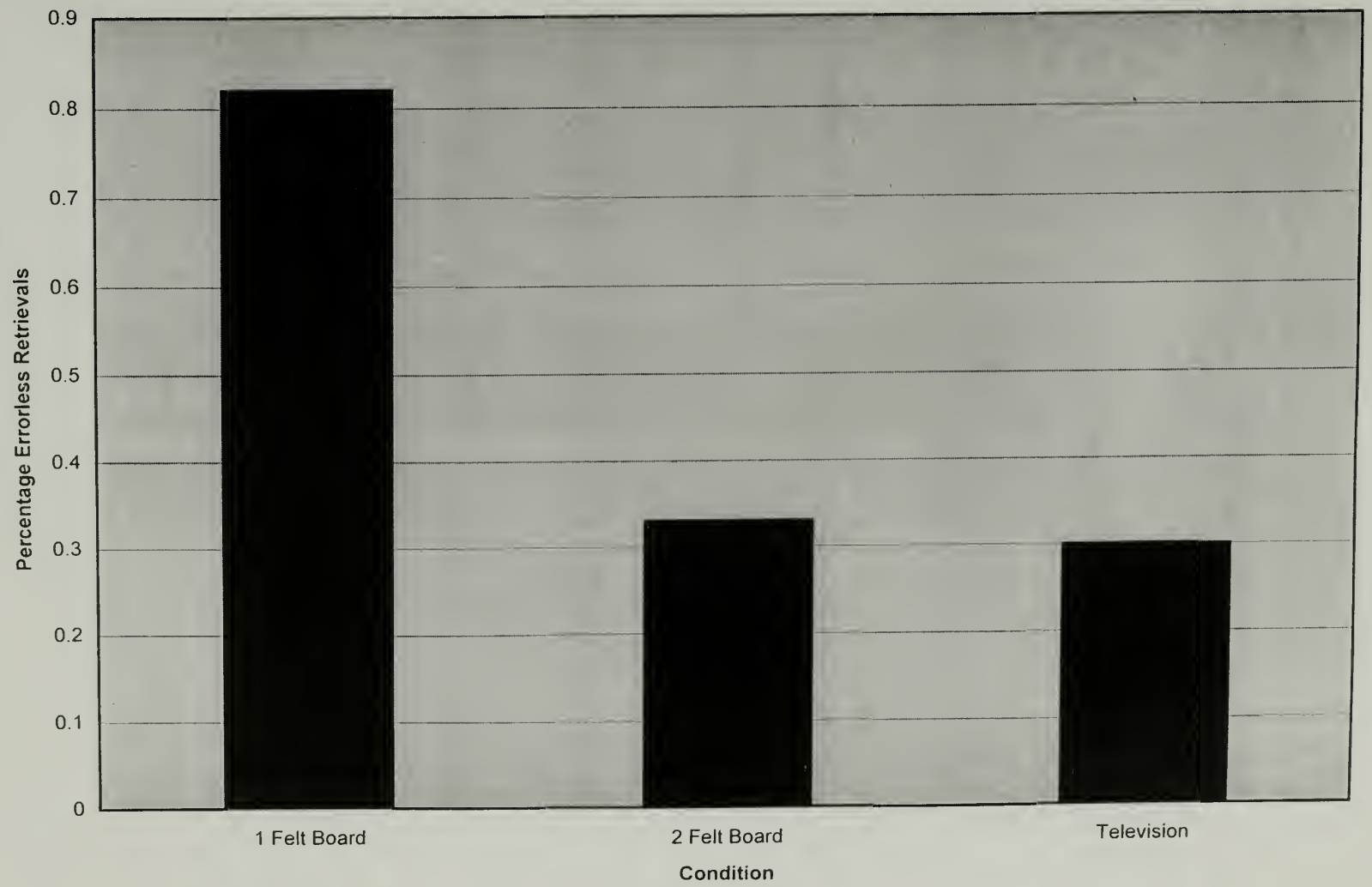


Figure 2: First Trial Performance Compared to Trials 2, 3, and 4

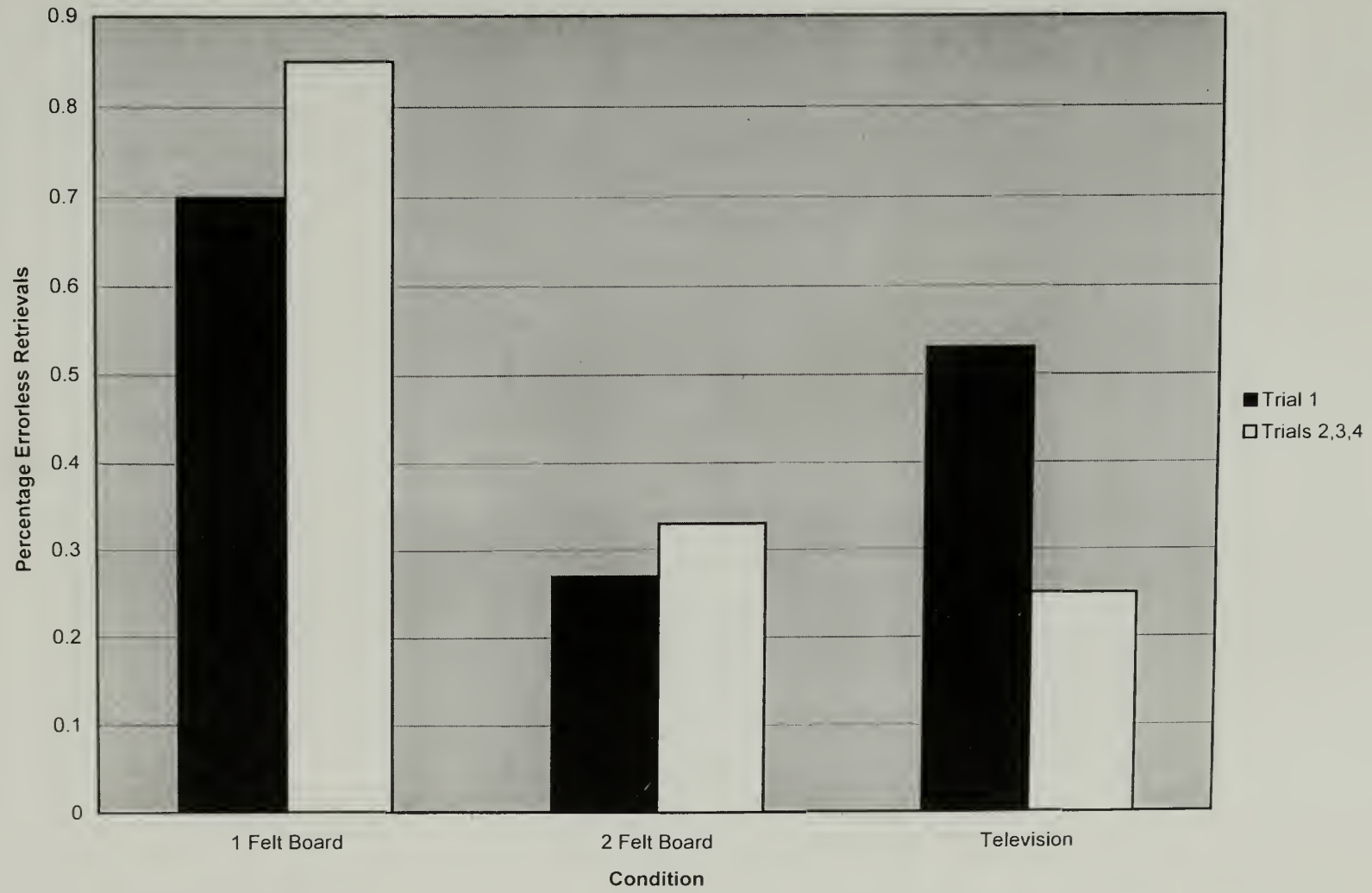


Figure 3: Perservative Errors

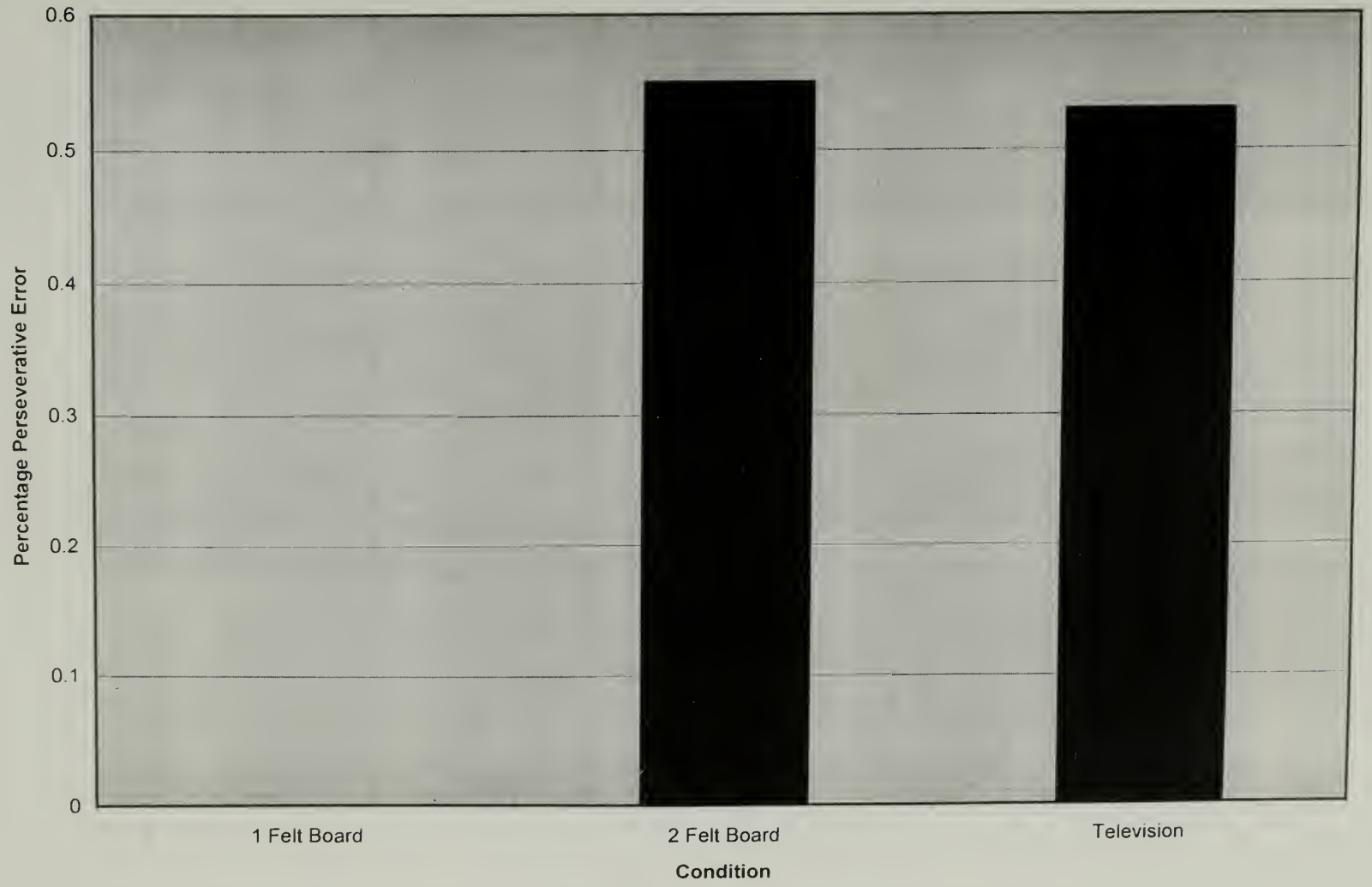
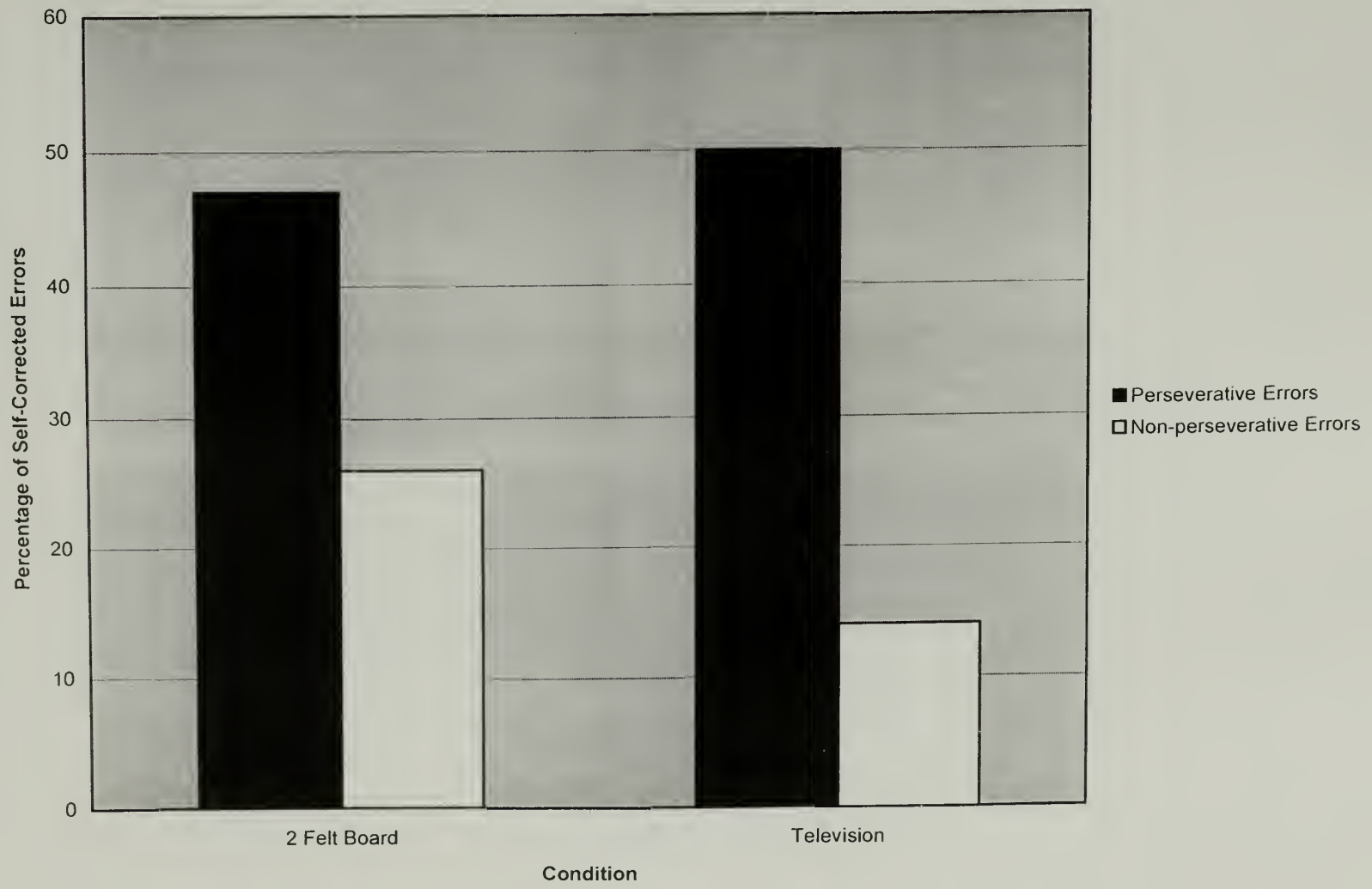


Figure 4: Self Correction after Error



APPENDIX

TELEVISION VIEWING QUESTIONNAIRE

1. Does your child ever ask to have the television turned on? YES NO
2. Does your child ever turn on the television by herself/himself? YES NO
3. Does your child change the channel by herself/himself? YES NO
4. Do you own a VCR? YES NO
5. In a typical week, approximately how many hours does your child watch television and/or videos?_____
6. When your child watches television and/or videos, how often does your child watch attentively?

   ALMOST ALWAYS MOST OF THE TIME SOMETIMES NEVER
7. What is your child's favorite program or video?_____
8. Which other programs or videos does your child watch?

   _____

   _____

   _____
9. Do you encourage your child to watch television or videos? YES NO
10. Do you own a video camera? YES NO
11. Do any close relatives own a video camera? YES NO
12. How many hours per month do you use your video camera?_____
13. Has your child ever seen a home video? YES NO
14. How often does your child see herself/himself on home video?

    NEVER RARELY OCCASIONALLY FREQUENTLY(at least once a week)

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