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Do Young Children Think of Television Images as Pictures or Real Objects?

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Three studies investigated whether 3- and 4-year-olds interpret television images as mere pictorial representations of objects or as real, physically-present objects. Four-year-olds gave clear evidence of making the former interpretation whereas 3-year-olds seemed to make the latter one. However, the data suggest that the younger children's errors reflect a failure to differentiate conceptually between television images and their referent objects rather than a conviction that real objects populate television sets.

There is considerable evidence that children's knowledge of the mental world increases markedly during the preschool years (Astington, Harris, & Olson, 1988; Harris, 1989; Perner, in press; Wellman, 1990). An important part of this "theory of mind" development is the growing awareness that people mentally represent (construe, interpret) external objects and events, and therefore that the selfsame single object or event may be mentally represented in several different, even contradictory-seeming ways (Flavell, 1988; Flavell, Green, & Flavell, 1990).

As examples, studies have shown that children aged 4-5 years or older understand much better than younger children that: (1) the same thing may give rise to different visual representations (look different) if viewed from different perspectives (Flavell, 1978); (2) the same thing may be represented incorrectly as well as correctly (as when someone holds a false belief) (Wimmer & Perner, 1983); (3) when seriating things by size, the same

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thing may be simultaneously represented as big (or bigger) in comparison to one thing in the series and as small (or smaller) in comparison to another (Flavell, 1963, p. 193); (4) the same thing may be verbally represented by more than one label (e.g., "cat" as well as "kitty") (Markman, 1989); (5) the same person may be represented as simultaneously occupying more than one social role (e.g., "Daddy" and "salesman") (Watson, 1986); (6) the same thing may be represented both as a scale model of something else and as an object in its own right (DeLoache, 1987, 1989); and (7) the same thing may be represented as looking like one thing but really being another (the appearance-reality distinction) (Flavell, 1986; Flavell, Green, & Flavell, 1986). According to Flavell (Flavell, 1988; Flavell et al., 1990), young children's problems in these diverse situations may have a common root cause: namely, that they tend to construe the stimulus in only one of the several ways possible; then, not realizing that their construal *is* a mental representation because they are not aware of the omnipresence of the representational process, they take it to be the only possible description of what the stimulus "is."

This developmental difference between younger and older children's understanding of the mind might influence how they are able to think about the images they see on the television screen. Television images are similar to scale models and illusory stimuli (6 and 7 above) in that they can be thought of in two quite different ways: (1) as two-dimensional moving pictures, situated on the screen right in front of the viewer; and (2) as the real, three-dimensional referents that these pictures portray, normally situated somewhere far away. Like the stimuli used in appearance-reality tasks, television images are not really the substantial objects they depict. They appear, however, in many respects to be real objects, and we automatically think and talk about them as if they were objects when watching television. Like scale models and other types of representations, they can be encoded either as what they are in themselves (pictures or light patterns, located on the TV screen) or as what they depict (real objects, located elsewhere).

If young children have an inadequate understanding of mental representation, they might respond to questions about images in the television set as if they were questions about their referent objects. They might do this for two reasons. First, like their elders, they normally "see right past" the image to its referent; the referent is what is salient for all of us, not the picture *qua* picture. Second, unlike their elders, they are relatively insensitive to the possibility of decentering from a salient representation, which they are not even aware *is* a representation, to consider an alternative, less salient one; for them, what is there on the screen "is" just the one salient thing it seems to be — the referent object. Consistent with this possibility, several studies (e.g., Markman, 1976; Piaget, 1929; Wellman, 1990) have shown that young children will often answer questions about words, pictures, and mental

images as if they were questions about their referents. For example, they might say "yes" to the question "Is the *word* 'rain' wet?" not because they actually think the word is wet, but because they misinterpreted the question to be about physical rain rather than verbal "rain." Markman (1976) found that her young subjects often made this error even when the experimenter explicitly told them the questions were about words and always stressed the term "word" in the question.

Of course, young children might also respond in terms of the television image's referent rather than the image because they really believe that the object that they see actually does exist in full object form inside the set. The aforementioned difficulty in thinking of the television image as an image could help to sustain such a belief; that is, if children encoded the stimulus only as an object, and not also as an image or picture, then the fact that the stimulus looks like it is in the television set might reinforce the belief that the object is, too.

There is some suggestive evidence that young children might be confused as to whether or not the televised image is a real object existing in the set. Atkin, Hocking, and Gantz (1979) surveyed young (ages 3-7 years) children's responses to television commercials. Of the 189 3- and 4-year-olds interviewed, 60% thought that when Ronald McDonald or Burger King came on television he could see them in their homes and 46% reported they thought they could talk to the televised character.

The studies reported here have a different objective than previous studies of children's understanding of television reality. Almost all of this previous research has used as subjects children older than 3 (e.g., Condry & Freund, 1989; Dorr, 1983; Hawkins, 1977; Leary, 1985; Morison, Kelly, & Gardner, 1981). The researchers also seem to have tacitly made the quite reasonable assumption that these older subjects readily distinguish between the proximal images on the screen and the distal referents they are meant to depict. The researchers' usual objective has been to find out how children construe, not the patterns on the screen, but rather their distal referents — objects and events that they naturally assume their subjects also think of as existing outside of the television set. Their research questions are of the following kinds: Do the children think that the people and animals seen on such-and-such a program are "real," live ones or "non-real" cartoon figures or puppets? Do they think that a given group of people (e.g., on a sitcom) are real family members spontaneously interacting in their home or are unrelated actors portraying a family in a studio? If children realize that what they see is a dramatization, can they judge accurately whether the actors are doing things that non-actors could or would do in real life, and whether they are acting their parts in a convincing, true-to-life fashion? To say that something seen on television is or is not "real" can obviously mean a number of different things, some more subtle than others. The research suggests that children only gradually sort out these different meanings as

they learn more about what life is like and how television programs are produced. Moreover, they must be making distinctions between representations and things represented, and between appearances and realities, as they do sort them out. For example, they will eventually be able to conclude that a commercial may be someone's deliberate *mis*representation of reality and that the group of people *appears* to be a family but *really* is not. But these older children are surely past a possible developmental period when it might be problematic for them even to distinguish conceptually between images in the set and the absent objects they depict. In contrast to previous studies, the purpose of our research was to find out whether such a developmental period exists.

We conducted three studies designed to find out whether 3- and 4-year-olds would fail to make the image-referent distinction and consequently respond as if they think that the objects they see on television are actually solid objects located inside the set. The experimenter asked subjects two types of questions: *reality* and *affordance.* The reality questions asked whether what was actually on the screen or in the set was a real object or a picture of an object. The affordance questions asked whether it could be acted on — that is, what possibilities for action it "afforded" (Gibson & Spelke, 1983) — or could itself act, as would be true if it were in fact a real, solid object presently inside the set. Thus, in the affordance questions we asked whether an object seen on videotape could be touched or could come out if the top of the set were removed, whether it would spill out of the open container it was in if the set were turned upside down, and whether a person seen on videotape could see, hear, and know about the experimenter's ongoing actions. Although both types of questions were included in the study, we felt the affordance questions would be the better measure to assess young children's understanding for four reasons: (1) they bypass the need to understand the terms "real" and "picture" in the way intended by the experimenters; (2) some young children may have constrained their interpretation of "picture" to mean photographs or line-drawings in story books, etc.; (3) some young children may have learned that the television image is labelled a picture (e.g. "turn that picture off"), but may still fail to conceptualize the image as a depiction of an absent object; and (4) the affordance questions should tap the child's spontaneous, implicit interpretation of what the proximal stimulus in the television set is like.

Study 1

Method

Subjects. The participants in all three studies were nursery school children drawn from Stanford University's laboratory preschool serving largely

upper-middle-class families. The Study 1 sample consisted of 18 3-year-olds, 6 boys and 12 girls (M = 3 years, 8 months; range = 3 years, 4 months to 3 years, 11 months), and 18 4-year-olds, 7 boys and 11 girls (M = 4 years, 9 months; range = 4 years, 6 months to 5 years). Each child in this and the following two studies was tested individually by a female experimenter experienced in the cognitive testing of young children.

Procedure: Training and tests. The training procedure was designed to: (1) illustrate the difference between "a picture of an X" and "a real X"; (2) provide evidence that the participants could correctly answer questions of a hypothetical sort similar to those subsequently used in testing, and were willing to give both "yes" and "no" answers to such questions; and (3) provide illustrations, in these questions, of different "theories" about the contents of a television set that young children might tacitly hold. Four small translucent refrigerator boxes were shown to the children in a fixed order. The boxes contained: (1) a real multicolored ball (representing the theory that real tangible objects are inside a television set); (2) a Polaroid photograph of a ball (representing the theory that a tangible photograph of a real object is inside the set); (3) nothing (representing the theory that there is no object in the set); and (4) a picture of an ice cream cone taped securely to the inside of the box (representing the theory that there are pictures inside the set but they remain inside). An example of the procedure with the boxes follows:

> The experimenter held up a box and said, "What's inside there? That's right (Actually), there's a real ball in there. If I take the top off this box (gesturing as if to remove top), and then I turn it upside down (gesturing as if to turn the box over), will a real ball come rolling out and bounce up and down on the table or not? Why (not)? That's right (Actually), the ball would come rolling out and bounce around, because it's a real ball."

The facts established for the photograph of the ball were that the stimulus was a picture of a real ball, not a real ball, and that, although it would fall out, it would not bounce like a real ball would. A few children thought at first that the photograph of the ball was firmly attached to the box and therefore would not fall out. With a short explanation, these children accepted the premise and were correct on all their answers. No other children made any errors.

In the testing procedure, the child was first shown four videotapes, one each of an inflated balloon, a glass bowl filled with popcorn, a horse moving around in a paddock, and ocean waves and roiling water. The balloon tape was always shown first; the other three tapes were then shown in counterbalanced order. The first question, asked about the balloon tape only, was the same question that had been asked initially about the

translucent boxes: the experimenter pointed down toward the top of the television from above and asked "What's inside the TV?" The children thus had a chance to express their naive concept, before being asked any probing questions that might suggest answers to them. While still viewing the videotape, the child was asked a question about the affordance of the image: "If I take the top off the TV (gesturing as with the boxes) and then I shake it, would a real balloon come floating out into the room and fly up to the ceiling or not? Why (not)?" No feedback was given. The three other tapes were then shown in their assigned order. While the child viewed each tape, the experimenter asked a similar affordance question about that image, asking whether a real "X" would spill out or walk out into the room if the top of the television were taken off and the television were turned upside down. In an effort to reduce children's possible tendencies to misconstrue our questions to be about the real world referent instead of that object's image, the experimenter took great care to accompany her test questions with appropriate gestures and pointing. "Why?" or "Why not?" was again asked after every item.

Next, the child was shown five items and asked a reality question about each one: "Is this a real 'X' or a (moving) picture of an 'X', or something else?" The five items were the ball in the translucent box, the picture of an ice cream cone taped to the inside of a box (easy, control items, always shown first and second), followed by the popcorn, horse, and ocean videotapes (the critical items). The order of choice between real and picture was counterbalanced. The horse and ocean images were described as "moving" pictures.

The testing concluded with another, slightly different affordance question about each of these same three videotapes: "If I stuck my hand down in there (the experimenter held her hand just above the top of the television), could I grab some popcorn for you and me to eat (would my hand get wet/could I feed him a carrot) or not?" These will be referred to as "touch X" questions.

We deliberately included two dynamic images (horse and ocean) and two static images (popcorn and balloon) for comparison purposes on the "come out" affordance questions. The dynamic images, more akin to the images children normally see on television, were anticipated to prove more difficult for children because of their realistic qualities. The static images, more akin to "frozen" photographs, were never shown moving during presentation to the participants, whereas the dynamic images moved continually.

Results and Discussion: Study 1

In response to the initial, "What's inside the TV?" question about two-thirds of the children at each age level simply said "balloon"; other answers included "picture," "tape," "nothing," "wires," and "motor." Beyond

possibly suggesting that children of both ages spontaneously focus on the referent rather than the image unless alerted to do the opposite, this result seems of little interest. Table 1 shows how children at each age level performed for each type of question. The individual percentages for each object are not shown because they were quite similar within a question type. Thus, contrary to our expectations, the dynamic and static images did not differ in difficulty on the "come-out" affordance questions; the "photograph-like" nature of the static images did not help the children. A 3 × 2 (Task [come out, real or picture, touch X] x Age) analysis of variance on the three stimuli for which all three questions were posed yielded a main effect for task, $F(2, 68) = 4.63$ $p < .01$, a main effect for age, $F(1, 34) = 17.26$, $p < .001$, and a significant age by task interaction, $F(2, 68) = 4.35$, $p < .02$. Subsequent tests for simple effects showed highly significant age effects for the "come out" question, $F(1, 34) = 14.78$, $p < .001$, and the "touch X" question, $F(1, 34) = 19.72$, $p < .001$, plus a near-significant age effect for the "real or picture" question, $F(1, 34) = 3.78$, $p < .06$. Posthoc t-tests (Tukey) showed that the 3-year-olds performed significantly better on the "real or picture" question that on the "come out" ($p < .01$) and "touch X" ($p < .01$) questions; no other within-group differences were significant. Although the 3-year-olds did somewhat better on the "real or picture" questions than on the affordance questions, as Table 1 indicates, performance on none of the question types exceeded chance expectation. Sixteen (88.9%) of the 18 4-year-olds correctly answered at least 7 of the 10 critical questions of these three types, whereas only 7 (38.9%) of the 18 3-year-olds did, $\chi^2(1) = 9.75$, $p < .01$. An explanation for a correct answer to a "come out" question was judged adequate if it included any of the following reasons for why the object would not come out if the top of the television set were opened and the set upturned: it was in a picture or on television; it was not real; it was just pretend; or no object was present. As the second row of Table 1 shows, at both age levels when children correctly said that the object would not come out they were usually able to explain why adequately. This suggests

Table 1
Percent Correct Responses to Each Question in Study 1

Question	Age	
	3	4
Would X come out?	41.7	88.9*
If not, why not?	83.3	92.2
Could I touch X?	33.3	87.0*
Is X real or a picture?	66.7	88.9*

*$p < .01$.

that their correct answers were not the result of random responding, guessing, or a yes or no response bias, but rather of a genuine conviction that the objects they saw on the screen were not physically present inside the set.

The evidence based on the aforementioned reasons speaks only to these children's abilities to make a loosely differentiated image-referent distinction. It says nothing about their understanding of the representational relationship of the image to its referent (e.g., that the image may *mis*represent the referent), an issue not addressed in these studies (see Perner, in press). Pearson product-moment correlations (range of 0-3) were computed for each of the three pairs of measures, separately for each age group. As Table 2 shows, with the exception of a nonsignificant "touch X"/"real or picture" correlation for the younger group, these correlations were moderate to high. This indicates that individual children, particularly the 4-year-olds, tended to be quite consistent in their tendency to respond to the television images either as pictures or as real objects.

The results for the 4-year-olds were very clear cut. Most of them gave consistent evidence of understanding our questions and of believing that the television image was a picture or something similar rather than a real, tangible object that could come out or be touched by one's hand. In contrast, the 3-year-olds often responded incorrectly, especially when answering the "come out" and "touch X" affordance questions. How to interpret their results is not as clear, however. The reality questions were potentially ambiguous. That is, the "this" to which the experimenter points when asking a reality question might be misconstrued as referring to the referent out there in the world rather than to the image right here in the set, despite the fact that she points at the set and gives "moving picture" as a response alternative. Although the 4-year-olds did not misconstrue them in this way, the potential ambiguity is arguably there. On the other hand, the affordance questions were not ambiguous, because they very clearly and specifically asked about the contents of the television set ("If I take the top off the TV and shake it . . ." and "If I stuck my hand down in here . . ."). If the 3-year-olds had a definite, conscious belief that there were no such objects

Table 2
Correlations Among Measures in Study 1

Measures	Age	
	3	4
"Come out" and "touch X"	.57	.55
"Come out" and "real or picture"	.59	.79
"Touch X" and "real or picture"	.16	.82

in the set, it is hard to see why they answered the affordance questions incorrectly, given that these questions so forcefully directed their attention to the interior of the set. Must we conclude, then, that they had instead an active, conscious belief that there were such objects in there? That is, of course, possible, but it is not the only possibility. A more likely one, we believe, is that they simply consider the referent object in isolation and think about what that sort of object can do. In doing this they do not focus on the image as such at all, and they also do not focus on the fact that the questions are about such objects inside the set, rather than about such objects in general. According to this interpretation, then, errors on our affordance questions are not the products of active, conscious beliefs that objects reside inside television sets; rather the children only think about what these objects do or are like wherever found.

Finally, no consistent sex differences were found for the various measures, in either this study or the two that followed it.

Study 2

This study was a further attempt to understand how 3-year-olds construe what they see on television. Two types of affordance tasks were used. The first was rather similar to the tasks used in Study 1. It was designed to find out whether 3-year-olds believe that televised images would, under the influence of gravity, behave inside the set more like physical objects would (i.e., fall) or more like depicted objects would (i.e., not fall). In these object tasks, children first saw that a real bowl of, say, popcorn spilled its contents when turned upside down but that a photograph of a bowl did not. Following these two control items they then were shown a videotape of a similar bowl and were asked whether its contents would or would not spill out if the set were turned upside down. The second type of affordance task (person task) was designed to reveal whether children of this age think that a person they see only on videotape could or could not see, hear, and know about the experimenter's current actions in the experimental room. As in the object tasks, the question about the videotaped person was preceded by two control questions accompanied by corrective feedback, one about whether a physically present person could see, hear, and know what the experimenter was currently doing, and the other about whether a person depicted in a photograph could. A reality question and another affordance question concluded the session.

The control questions with their corrective feedback were intended to structure and clarify the video questions. Having just been given information that physically present people perceive and actual objects fall but that still photographs of people and objects do not, participants should understand what is asked of them when similarly questioned about television

images of people and objects, and they should reveal in their answers whether they regard them as being more like physically present objects or more like photographs. In order to preserve somewhat the ecological validity for television of the images viewed by the children, all stimuli were first presented in a dynamic fashion (e.g. juice was poured into a glass or the person was shown to be moving) prior to a previously specified stop frame where the image was frozen and the test questions asked.

Method

Subjects. The participants were 24 3-year-olds, 15 girls and 9 boys. The mean age was 3 years, 5 months, with a range of 3 years, 1 month to 3 years, 11 months. None of these children had participated in Study 1.

Procedure: Training, tasks, and probes. The child was shown a block tower on the table and then a photograph of a block tower. In each case he or she was asked if the blocks would fall down if the table or photograph were shaken. After the child answered, the experimenter shook the table or photo to demonstrate. Somewhat to our surprise, six children predicted that the blocks in the photograph would fall over. The experimenter pointed out that they had not fallen down when the photograph was shaken and reasked the question. All were then correct.

In object and person tasks alike, three tasks were administered in counterbalanced order. Each task included three subtasks (real, photo, and video). The real and photo subtasks were always given first (in counterbalanced order), with the video subtask always following. The child was asked to predict what would happen if the stimulus (real, photo, or video) were turned upside down. Feedback was given immediately after the real and photo subtasks; no feedback followed the video subtasks. An example of a set of object subtasks follows:

> *Real:* The experimenter held up a glass of water and said, "If I turn this glass upside down will the water spill out of this glass or not?" After the child answered, the experimenter said, "Look what happens!", turned the glass upside down, and said, "That water spilled out!"

> *Photo:* The experimenter held up a photograph of a glass of milk and said, "If I turn this paper upside down, will the milk spill out of this glass or not?" After the child answered, the experimenter said, "Look what happens!", turned the photograph upside down and said, "That milk didn't spill out!"

> *Video:* The experimenter showed the child a video of a glass of juice and said, while gesturing as if to do so, "If I turn this TV upside down, will the juice spill out of this glass or not?" No feedback was given after the child's answer.

In the other two tasks the liquids were replaced by solid objects (popcorn, cereal, crackers) in bowls and by hats on different people's heads.

The following illustrate person tasks:

Real: The experimenter squeezed a rubber frog noisemaker, and said, "I'm squeaking a frog. Do I hear this frog right now or not?" After the child's answer, the experimenter said, "That's right (Actually), I can hear the frog right now. I'm right here in the room."

Photo: The experimenter placed an 8 × 10 inch front-view photograph of a seated man on the table vertically. The man was looking just to one side of straight ahead, so there was no sense of eye contact with him. The experimenter said, "Here's Jim." She then banged a drum and continued to bang it during questioning. "I'm banging a drum. Does Jim hear this drum right now or not?" After the child's answer, the experimenter said, "That's right (Actually), he can't hear the drum right now. He's not really here in the room with us right now."

Video: The experimenter turned on a video of a seated woman, who was also looking just to one side of straight ahead. "Here's Ruth." The experimenter rang a bell and continued to ring it during the questioning. "I'm ringing a bell. Does Ruth hear this bell right now or not?" There was no feedback. In the other two tasks, the questions concerned seeing a toy that the experimenter held up and knowing what gesture the experimenter and child were visibly making.

After both sets of tasks had been administered, the child was asked two additional questions (probes) in counterbalanced order:

Object probe: The child was shown the last object video he or she had seen. The experimenter pointed to the object and asked the reality question, "What's here right now? Is that a real 'X' or a picture of a real 'X'?" The choices were given in counterbalanced order.

Person probe: The child was shown the video of the woman and asked the affordance question, "If we could take the top off the TV, could Ruth get up out of that chair and step into this room?" If the child said yes, the experimenter asked, "If she came out, how big would she be? Would she be this big?" (the experimenter measured against the screen size), "Or would she be this big?" (the experimenter held her hand at adult height).

Results and Discussion: Study 2

A 2 x 2 x 3 (Task x Task Order x Subtask) analysis of variance yielded as its only significant finding a main effect for subtask, $F(2,44) = 6.55$, $p < .01$.

Subsequent posthoc *t*-test comparisons (Tukey) showed that children were correct significantly more often on the real subtasks than on the photo ($p < .01$) and video ($p < .01$) subtasks, with the latter two not differing significantly in difficulty. Correct responses to the object subtasks for the real, photo, and video questions were 88.9%, 75.0%, and 66.7%, respectively. The corresponding figures for the person subtasks were 88.9%, 66.7%, and 69.4%. Although it is apparent from these figures that the object and person video subtasks proved to be of almost identical difficulty, the Pearson's correlation between the two sets of subtasks was only .27. There were also no substantial differences in difficulty among the three types of person video subtasks (see, hear, and know), and the same was true of the three object video stimuli (liquids, solids, hats). As to the two probe questions that concluded the testing session, 19 children (79.2%) correctly answered the object reality question and 14 (58.3%) correctly answered the person affordance question. Of the 10 children who responded incorrectly to the latter, 6 said in response to the follow-up question that the person would be human-sized if she came out of the set, whereas the other 4 said she would be the same size she was on the screen. What to make of their answers is not clear, except that conflating image and referent can lead to either of two equally absurd conclusions! In general, 3-year-olds seem to fare somewhat better on Study 2 tasks than on Study 1 tasks, perhaps because of the new features noted in the introduction to the present study. In contrast to Study 1, performance was better than chance expectation ($p < .05$) on each question of the person and object control and test questions, as well as the object reality probe. Although not very high in absolute terms, the 66.7-69.4% level of correct performance on the video subtasks of Study 2 is somewhat better than the 33.3-41.7% level of correct performance by 3-year-olds on the rather similar "come out" and "touch X" tasks of Study 1 (Table 1). Likewise, only 54.2% of the children responded correctly to at least six of the eight video and probe questions in Study 2, but that is at least marginally better than the 38.9% who reached a similar criterion (at least 7 of 10) in Study 1.

The most surprising result of Study 2, however, was the children's relatively poor performance (66.7-75.0% correct) on the photo control subtasks. In addition to looking as if they would be very easy, even for young children, these subtasks included repeated corrective feedback designed to persuade subjects that depicted objects do not fall out of depicted containers and that depicted people cannot perceive us. Nevertheless, errors were just as frequent on later photo subtasks as on earlier ones, indicating that the children did not benefit from this feedback. These errors contribute to the finding that the children were correct on all three questions (real, photo, and video) of a single task on only 53.5% of the 144 possible occasions. We believe that children erred on photo trials for the

same reason they erred on video trials: because they thought only about the referent when answering the question, wholly ignoring the physical photograph that depicted it. They erred because they had difficulty thinking of the photograph as a depiction, just as they did in thinking of the television picture as a depiction. This conjecture is supported by the fact that the children responded very similarly to the photo and video questions. For example, the correlation between the two measures was .81. Furthermore, on 84.3% of the subtasks in which children correctly answered the photo question, they then went on to correctly answer the ensuing video question; the figure was 84.6% for subtasks in which they correctly answered both photo and real questions. These results suggest that on trials in which children somehow managed to focus their attention on the television screen itself, perhaps by having just done the same with the photograph, they were likelier to construe it as a tableau of depicted objects than as a window through which they saw real, three-dimensional objects. Alternately put, on those trials in which they successfully distinguished between the affordances of objects and pictures, they usually went on to implicitly identify the television stimulus as a picture rather than an object.

Study 3

Study 3 was a near-replication of the object-task portion of Study 2. The main difference was that in Study 3 the children were given factual rather than hypothetical questions, a manipulation that we thought might improve their performance. That is, the experimenter actually turned a 12-inch portable television upside down behind a screen and then asked the subjects whether the televised object *had* fallen, rather than, as in Study 2, asking whether it *would* fall *if* the set were turned upside down.

Method

Subjects. The participants were 26 3-year-olds, 9 girls and 17 boys. The mean age was 3 years, 5 months and the range 3 years, 1 month to 3 years, 11 months, as in Study 2. None of the children served in either of the two previous studies.

Procedure. The testing session began with the Study 2 training procedure and ended with the Study 2 object probe (a reality question). Five affordance object tasks were given in random order immediately following the training; the order of the choices within each question was also randomized. As in Study 2, within each task the real and photo subtasks always preceded the video one, and feedback was given only on the real

and photo subtasks. Half of the sample always experienced real subtasks before photo ones, and half the reverse.

To illustrate the nature of these tasks, in the real subtask of one of them the experimenter showed the child a Snoopy doll sitting in a little chair, then took them behind a screen and turned the chair upside down so that the chair's upturned legs were visible to the child above the screen. The experimenter then said: "I turned this chair upside down. Did Snoopy fall off this chair or did Snoopy stay on this chair?" After the child answered she demonstrated what had actually happened, saying: "Look what happened. Snoopy fell out of this chair!" She followed the same procedure with an 8 x 10 inch photograph of a man sitting in a chair ("I turned this paper upside down. Did this man fall off this chair or . . . ?"). Then, after showing that the man stayed in his chair when the picture was turned upside down, she repeated the procedure with a video of a woman sitting in a chair ("I turned this TV upside down. Did this woman fall off this chair or . . . ?"). As in Study 2, on video subtasks the image was first presented in dynamic fashion; for example, the woman was first shown seating herself in the chair before the image was frozen and the television set placed behind the barrier. On the real subtasks care was taken to muffle any sounds indicating that objects had actually fallen out; in retrospect, we believe that this lack of noise may have led a few children to err on these subtasks. The other four tasks were administered in the same way. Three of them were nearly identical in content to the three used in Study 2, featuring hats that fall off, and liquids and solids that spill; like the Snoopy task, the remaining one involved an object that falls out of a receptable.

Results and Discussion: Study 3

Despite the manipulation of asking only factual, nonhypothetical questions in Study 3, we found the children's performance to be very similar to that in Study 2. Children were correct on 88.9%, 75.0%, and 66.7% of the real, photo and video object subtask questions in Study 2; the corresponding figures in Study 3 were 82.3%, 76.9%, and 78.5%. Although the 78.5% correct figure on the video questions in Study 3 appears a bit better than the 66.7% figure from Study 2, this difference is not significant by *t*-test. Further, a 2 x 3 (Study x Subtask) analysis of variance on the three object tasks that were the same in Study 2 and Study 3 revealed no significant main effects or interactions. Performance on the object probe was somewhat poorer than in Study 2 and not above chance expectation (57.7% vs. 79.2%). Considering again just the three object tasks plus the reality probe that the two studies shared in common, 66.7% of the children in Study 2 and 69.2% of the children in Study 3 reached a criterion performance of at least three correct responses to four questions. A final figure indicating comparability of performance between the two studies is that 53.5% of the

Study 2 and 55.4% of the Study 3 trios of questions were answered correctly (real, photo, and video). These comparable figures suggest that children's difficulties in Study 2 in correctly answering our questions were not attributable to the hypothetical nature of the questions. In Study 3, however, where children were given only object subtasks over more trials, 80.8% of the children responded correctly on at least four of the six key questions (five video plus one reality). This performance is fairly impressive and approximates the level of success the 4-year-olds displayed in Study 1.

As in Study 2, children sometimes erred on the apparently easy real and photo subtasks as well as on the video ones and were as likely to err on later photo subtasks as on earlier ones; unlike the case in that study, however, the three subtasks did not differ significantly in difficulty. As in Study 2, good performance on the photo subtasks was associated with good performance on the video subtasks; the correlation between the two was .67, and in 88.0% of the trials on which subjects had correctly answered a photo question, they also correctly answered the video question that followed it. (The corresponding percentage is 84.5% for trials on which both photo and real questions had been correctly answered.) Once again, this suggests that on the occasions when 3-year-olds do manage to distinguish the affordances of objects and pictures, they construe the television screen to be more akin to a picture than to a window with real objects behind it. Had they viewed it as a window on those occasions, they presumably would have said that the objects behind it would fall, just as objects outside the set did on the real subtasks.

General Discussion

In this article we described three studies of young children's interpretation of television images, one using both 3- and 4-year-olds as participants (Study 1) and two using only 3-year-olds (Studies 2 and 3). Almost all of the 4-year-olds gave clear and consistent evidence of understanding that the things they see on television are not actually present as solid, three-dimensional objects inside the set (see Table 1). Responding to the reality questions, they said that what they saw on the screen were pictures rather than real objects. Similarly, responding to the affordance questions, they said that what they saw could not be touched (grabbed, fed, make one's hand wet) and could not come out of the television if the top of the set were removed. In fact, a number of the 4-year-olds acted as if they thought the answers to such questions were obvious, and the questions themselves rather silly. There is of course always the danger that questions that seem to the investigator unambiguous and easy to process will not be correctly interpreted by young children. Ours certainly must have seemed novel and strange to 3- and 4-year-olds. In addition, although we tried to make the

questions as clear as possible, our hypothesis about young children's difficulties with multiple representation suggested that young children would be susceptible to misinterpreting them as being about the referent rather than the image. However, the finding that the 4-year-olds answered our questions correctly 87.0-88.9% of the time shows that they did not misunderstand them. This in turn suggests that if our 3-year-olds spontaneously construed questions about television images the same way as did our 4-year-old children, they should also have been able to answer them correctly. The results of Study 1, however, suggest strongly that a substantial number of 3-year-olds did not spontaneously construe these affordance questions the way the 4-year-olds did. Indeed, without the addition of Studies 2 and 3, we might have been led to the premature conclusion that some 3-year-olds actually believe real objects inhabit television sets. The children in these studies were children from largely upper-middle-class, well-educated families attending a university lab school. It is, therefore, more than possible that 3- and 4-year-olds from less privileged backgrounds would show less understanding of television images. It is also possible that our participants would have performed better if we had been able to devise good nonverbal measures of their understanding.

Table 3 summarizes the 3-year-olds' performance on the affordance and reality questions in these three studies. It is clear that with training and feedback experiences in Studies 2 and 3, the 3-year-olds are responding correctly above chance expectation to the key affordance questions, suggesting strongly that they do not believe that real objects are actually present in television sets. An effort was made to compare the three studies directly by performing a 3-way ANOVA using percentage correct of the total object "come out" questions in each of the studies for each child. This analysis yielded a significant main effect for study, $F(2,65) = 4.76$, $p < .01$. Subsequent Tukey t-test comparisons showed that the children were correct significantly more often in Study 3 than in Study 1 ($p < .01$). As

Table 3
Percent Correct Responses of 3-Year-Olds to Main Questions in Studies 1, 2, and 3

Question	Study		
	1	2	3
"X" real or picture?	67.7	79.2*	57.5
"X" come/fall out?	41.7	66.7*	78.5*
Could we touch "X"?	33.3	—	—
Could "X" perceive us?	—	69.4*	—

*$p < .05$.

indicated previously, performance in Study 3 is rather impressive, with 80.8% of the sample meeting the criterion of good performance (four correct responses of six questions). These study comparisons, the above-chance performances in Studies 2 and 3, and the high percentage of children achieving criterion performance in Study 3 suggest that training and feedback experiences designed to make the affordance questions as unambiguous and easy as possible enable most 3-year-olds to answer them correctly. In a sense this good performance is rather remarkable. How are 3-year-olds to know what will happen to what they see on the screen when a television is turned upside down? After just having seen, say, juice poured into a glass on the screen, why don't they simply bypass the intent of our affordance question, and simply reason, "Well if it went in, then it will fall out"? Nevertheless, when subjects in both Studies 2 and 3 were able to focus their attention on the specific media being queried, and hence were correct on our control real and photo questions, they treated the television image more like a picture than a real object, thereby giving evidence that they do not actually think real objects inhabit television sets.

It is also true, however, that sizable minorities of the 3-year-olds in both Studies 2 and 3 did poorly on both photo and video affordance questions. Recall that in Studies 2 and 3 only 53.5% and 55.4% of the tasks were totally correct (real, photo, and video). A sizable minority of children across the three studies said that a videotaped stimulus is potentially touchable, could come out of the set, and is able to fall out of its open container inside the set, and that a person shown on videotape would be capable of perceiving and knowing what the viewer is doing. Children also often responded to the reality question in the three studies by claiming that what was present on the television was a real object rather than a picture of a real object.

Our interpretation of the 3-year-olds' errors is the following. Children of this age are likely to look at a videotaped stimulus and automatically encode it only as the referent object. Because, by hypothesis, they know little about mental representation and are relatively insensitive to the appearance-reality distinction, they have difficulty thinking of the stimulus as representable both as an image or picture and as the referent object it depicts; the referent, being more salient than the image, therefore usurps all of their attention. Consequently, they answer our questions in a way that would be correct had the questions referred only to the referent considered in an abstract, context-free manner — not as being of *this* apparent size and located inside *that* television set. That is, they answer by saying that the stimulus is real, can be touched, can perceive us, etc., without specifically thinking about where it is located at all. The 3-year-olds' proneness to error on the seemingly very easy photo tasks in Studies 2 and 3 supports this interpretation. It is hard to see why they would ever say that depicted milk

would fall out of a depicted glass "if I turn this paper (i.e., the photo) upside down," unless they were thinking not of the picture as such, but only of its referent. It seems likely that their errors on the video tasks had exactly the same cause. Interpreted in this way, these errors add to the growing body of evidence that 3-year-olds have a poor understanding of representations (Perner, in press; Zaitchik, 1990).

In summary, then, our data suggest that most 3-year-olds (a) do not actively believe that the object images they see on the television screen are actually real objects located inside the set, but (b) they cannot easily show us that they do not believe that because of difficulties in conceptually distinguishing images from their referents. These difficulties in turn are presumed to result from a more general lack of knowledge about representations. Where do they and the 4-year-olds fit in the overall development of children's understanding of television reality? We tentatively propose the following four-step developmental sequence of this understanding. Although derived in part from our results and those of others, it should be regarded mainly as a set of speculations for guiding future research.

Step 1. Children probably begin by tacitly assuming, for lack of information to the contrary, that what they see are real, tangible objects, physically present on or behind the TV screen. In reporting a longitudinal study of three children's developing understanding of television, Jaglom and Gardner (1981) make a claim that is consistent with this possibility:

> Children [2-year-olds] indicate a belief that the two spheres [television and daily life] are identical, not separate and self-contained. 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. (p. 24)

Since a television image does look in certain respects like a real, physically-present object, it would not be surprising if neophyte viewers responded as if it were, much as infants do at first with mirror images (Lewis & Brooks-Gunn, 1979) and even, perhaps, still pictures (Perner, in press).

Step 2. In time, children learn that television images do not behave like ordinary objects. Unlike the case with ordinary objects, the viewer cannot touch or manipulate them, and the animates among them do not respond to the viewer. Although children have learned in this period that television images are not physically present real objects, we speculate that they have not yet learned what they are instead — namely, depictions of objects or events not present. That is, they have not yet acquired a clear and definite belief that what they see on television, while not taking place in the set, does take place somewhere, and thus that the television image is a pictorial

representation of a three-dimensional reality that happened somewhere else. Lacking such a belief, they do not explicitly interpret what they see either as mere pictures on the screen (images) or as particular real objects existing someplace else (referents). Needless to say, questions about the reality status and affordances of the images cannot be clearly communicated to such children. We assume that most of the 3-year-olds in our studies were roughly at this step in the developmental sequence, or possibly the beginning of the next.

Step 3. Children come to understand that the image iconically depicts an absent reality, and that the object they "see" (see the image of) exists somewhere in the outside world. They are gradually developing a representational conception of television and other pictures (Perner, in press). Children now believe that still photographs and drawings are images of realities and faithfully portray those realities (DeLoache, 1987; O'Connor, Beilin, & Kose, 1981; Zaitchik, 1990). They also interpret television images in the same way, and can readily distinguish reality and affordance questions asked about television images from those asked about the referents of those images. Thus, we would locate our 4-year-olds somewhere at this step. When children learn during this period that television images represent outside referents, it would be only natural for them to think that the images represent these referents with perfect fidelity, and thus that the referents are always exactly as they seem or appear to be to the television viewer. They have learned that television images represent, but have not yet learned that they may also *mis*represent as well (Perner, in press). Accordingly, at this step in the sequence children tend to have what Hawkins (1977) referred to as a "magic window" conception of television reality, one in which referents are always assumed to be just as they are portrayed to be in their images. Step 2 children also take what they see on the screen as trustworthy information about the world, even though they may not explicitly construe it as something happening somewhere else. Thus, at both steps in their development children "take seriously" what they see on television in the sense of uncritically incorporating it into their conception of how things are in the world.

Step 4. Children gradually learn what television content is real or realistic and what content is not. This is the developmental progression that most previous studies in this area have documented, as we noted in the introduction.

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