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Early understanding of the representational function of pictures

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Abstract

An important function of pictures is the communication of information – a function that has been ignored in research on the development of pictorial perception and comprehension. When are young children first capable of using pictures as a source of information to guide their behavior? The six studies reported here reveal a dramatic developmental change between 24 and 30 months of age in the use of pictorial information about the location of a hidden object. When presented with a picture that showed the location of a hidden toy, 30-month-olds readily retrieved the toy, but 24-month-olds did not. The extremely poor performance of the 24-month-olds was replicated and shown to persist in spite of various modifications made in the task in an effort to improve performance. We conclude that our 24-month-old subjects did not interpret the pictures as representations of current reality. We propose that very young children's early pictorial experience may predispose them to be overly conservative in interpreting the relation between pictures and their referents.

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1. Early understanding and use of pictures as representations

Early in life humans adopt various symbol systems such as gestures and language. Among the milestones of a child's development are the first wave and the first word – actions that reflect the acquisition and use of symbols. Well before children produce such symbols themselves, they understand a variety of words and gestures used by others.

Pictures constitute another symbol system to which children in Western cultures receive very early exposure, with joint picture-book reading being a favorite form of parent–child interaction. Do infants and toddlers understand pictures in more or less the same way that older children and adults do? In other words, is the representational relation between a picture and its referent transparent?

This question has long been debated by philosophers, anthropologists, and psychologists. One position is that all pictures are cultural conventions and that picture perception and interpretation is learned through experience (e.g., Gombrich, 1960; Goodman, 1968). At the other extreme is the claim that because pictures contain the same higher-order, invariant information as what they depict, no special experience or ability is required for picture perception (Gibson, 1971, 1980).

This long-standing debate has been, we assert, prematurely foreclosed by research revealing that young infants can recognize pictures of familiar people and objects. This fact has been misinterpreted to mean that pictures are "understood" by infants. This interpretive error stems in part from a common failure to distinguish between recognition versus comprehension or understanding of pictures, in spite of the fact that Sigel (1978) long ago pointed out the necessity of drawing such a distinction. Consequently, there has been almost no research on young children's appreciation of the relation between pictures and what they depict. As Beilin and Pearlman (1991) noted, we know remarkably little about how children come to understand pictures as representations of reality.

In this paper, we begin by emphasizing the distinction between picture perception or recognition and picture comprehension. We then focus on young children's understanding of picture–referent relations. Several studies are reported that focus on very young children's use of pictures to guide their search for a hidden toy. The results reveal that 2-year-old children have a surprising degree of difficulty understanding that pictures can serve as a useful source of information about a current situation. Finally, these results are discussed in terms of the general development of pictorial competence and the long-standing debate about the role of experience in understanding pictures.

1.1. Picture recognition

With respect to the *recognition* of pictures, there is substantial evidence that

learning is not required. The classic developmental investigation was Hochberg and Brooks' (1962) heroic study of their own child. With great effort, they kept virtually all pictures away from the child until he was 19 months old. When he was then tested for identification of photographs and line drawings of familiar objects and people, the child readily named the depicted items.

Several studies have since shown that even much younger infants perceive two-dimensional information and can recognize faces, objects, and abstract patterns in pictures (Barrera & Maurer, 1981; DeLoache, Strauss, & Maynard, 1979; Dirks & Gibson, 1977; Rose, 1977). For example, DeLoache et al. (1979) familiarized 5-month-old infants with one of two small dolls. In a subsequent visual preference test, the babies were shown either the actual two dolls or pictures of the dolls. The infants tested with the pictures behaved just like those tested with the dolls; they looked longer at the novel one, indicating that they recognized the picture of the familiar doll.

This precocious recognition of pictorial content was not due to a simple failure to discriminate between two- and three-dimensional stimuli. DeLoache et al. presented a separate group of 5-month-olds with a doll and a picture of that doll in a standard visual preference test (with no prior familiarization). The infants looked longer at the real doll than at its picture, showing that they could discriminate between them. Other studies have also reported discrimination between photograph and referent by young infants and even newborns (Slater, Rose, & Morison, 1984).

The results of research on infants' response to simple pictures are thus unambiguous. (1) Even very young infants are sensitive to and can pick up the higher-order information that is invariant in two- and three-dimensional versions of the same entity (as expected by Gibson, 1971). Recognition of a pictured object is accomplished in spite of the absence of many depth cues (e.g., binocular cues, motion parallax). (2) Infants can discriminate between objects and their pictures, showing that the depth cues are not ignored. Thus, infants distinguish flatness from three-dimensionality.

1.2. Picture comprehension

Do these early abilities mean that infants know what kind of thing a picture is and how it relates to what it depicts? The Hochberg and Brooks and other infant studies are often taken as evidence that even infants "understand pictures". However, as Sigel (1978) noted, "simplicity of recognition should not be mistaken for . . . ease of comprehension" (p. 108).

Indeed, there are several reasons to suspect that recognition of a depicted object is not equivalent to understanding the nature of pictures or the relation between a picture and its referent. One reason is the existence of numerous

anecdotal reports of tactile exploration of pictured objects by infants and toddlers, including attempts to grasp or pick up pictures from the pages of books (Murphy, 1978; Ninio & Bruner, 1978; Perner, 1991; Werner & Kaplan, 1963).

In research currently under way, we are formally documenting this phenomenon, examining infants' manual exploration of color photographs of objects (DeLoache, Uttal, Pierroutsakos, & Rosengren, research in progress). Every 9-month-old infant we have observed to date has tried at least once to pick up a depicted object. Some infants are extremely persistent, making repeated efforts to grasp the pictured object. The seriousness of their intent is indicated by the fact that the infants make more efforts to grasp objects that are scaled to the size of their hands (i.e., quite small objects that the infants could actually grasp if they were real) than larger objects that are too big for these infants to grasp.

These results indicate that, in spite of the recognitory and discriminatory abilities present in early infancy, infants do not know what kind of thing a picture is. Although they recognize that an object and its picture differ, they are ignorant of the fact that one is graspable and the other is not. Their precocious picture perception abilities thus do not include knowledge of one of the crucial defining features of pictures.

Other reports indicate that older children may also experience difficulty sorting out the relation between pictures and reality (e.g., Flavell, Flavell, Green, & Korfmacher, 1990; Zaitchik, 1990). For example, Beilin (1983, 1991; Beilin & Pearlman, 1991) coined the term "iconic realism" to refer to confusion between properties of photographs and properties of the objects they depict. He reported that 3-year-olds sometimes attribute more properties of real objects to their pictures than is appropriate. For example, some children responded affirmatively when asked whether a photograph of a rose would smell sweet and whether a picture of an ice cream cone would be cold to touch.

Another reason to suspect that the picture–referent relation may not be transparent to very young children comes from research on young children's understanding of a different type of symbol: scale models (DeLoache, 1987, 1989a, 1989b, 1990, 1991; DeLoache, Kolstad, & Anderson, 1991). This research has shown that appreciating the relation between a symbol and its referent can be surprisingly difficult, even when a high degree of iconicity exists between them.

In the task used in this research, young children watch as an attractive toy is hidden in a model of a full-sized room. The child is then asked to retrieve a similar but larger toy hidden in the corresponding place in the room itself. Thus, to succeed, the child has to understand something about the relation between the model and the larger space it represents. Thirty-month-old children fail most versions of this task, but children only 6 months older are usually quite successful; 36-month-olds use what they know about the location of the toy in the model to infer the location of the toy in the room.

The extreme difficulty that young children have exploiting the symbol–referent

relation in the model suggests the possibility that the same problem might occur for other symbol systems. Perhaps the relation between a picture and its referent would be similarly difficult at some age.

1.3. The picture task

We know that is is not difficult for 30-month-old children; they readily detect the relation between a picture and its referent in a task that is highly similar to the model task. In a series of studies, DeLoache (1987, 1991) compared young children's performance with pictures versus scale models. In various picture conditions, the location of the hidden toy in the room was communicated by the experimenter's pointing to the relevant place (piece of furniture) in a picture. The 30-month-old subjects readily used the information in the picture to guide their searching, and their first search was correct approximately 80% of the time.[1]

Could even younger children exploit pictorial information the same way? The precocious picture recognition abilities of infants would suggest that 24-month-olds might be successful in our picture task, but the evidence that even preschool children show less than full picture comprehension makes one less optimistic. The purpose of the present research was thus to examine the performance of 24-month-old children in our picture task in which 30-month-olds have been so successful. Before describing this research, it should be useful to analyze the picture task in some detail. We will take as an example a situation in which a picture depicts a stuffed Big Bird toy behind a chair (the type of picture used for all but the first and last experiments reported here). Children are shown the picture, told that it shows where the toy is hidden in the room, and encouraged to retrieve the toy. What is required for success?

First, the children must *recognize the objects* in the picture. They must identify that the picture shows a Big Bird toy and a chair. In addition, they need to perceive the *relation between the depicted objects*; specifically, that the toy is *behind* the chair. In our task, children do not have to make very precise

[1]The picture studies were originally designed to test the *dual representation* hypothesis (DeLoache, 1987, 1991): the assertion that scale models are especially problematic for young children because a model is both a real (and highly salient and attractive) object and a symbol for something other than itself. To succeed in this task, children must think about not only the model itself as an object, but also what it represents. Pictures do not require such a dual orientation. They are not salient or interesting as objects, and to use them one need think only of the depicted referent and not at all of the picture itself. The otherwise counterintuitive prediction was thus made that young children should perform better if given information about the location of the hidden object via pictures rather than the model. The fact that performance was indeed superior with pictures (a result that has been replicated several times in our laboratory as well as others – Dow & Pick, 1992) thus supported the dual representation hypothesis.

judgments about spatial relations, but they do need to notice that the toy and the piece of furniture are spatially contiguous.

As a result of identifying the objects and the spatial relations among them, the children must *interpret the picture*. They must construct some sort of meaningful "mental model" (Perner, 1991) of the depicted situation. That is, they must form a mental representation of a Big Bird toy on the floor behind a chair.

At the same time, the children must *discriminate between the picture and reality*, as well as between their mental model based on the picture and that based on direct experience with the depicted toy, chair, and room. It would never do to confuse reality with a representation of reality (Kennedy, 1974).

In addition, the children must *understand the relation* between the picture and what it depicts. They have to realize that the picture represents an actual, current situation. There are many possible relations – a fact not often acknowledged in the literature on picture perception in infants and children. (The variety of picture–referent relations will be discussed later in this paper.) There are many clues available in our picture task to help children figure out that the pictures we show them depict current reality. For one thing, our pictures are highly realistic color photographs and hence not sheer fantasy. For another, the children have had immediate past experience with the depicted objects and the room in which those objects are located. Most important is the social context: we tell our subjects precisely what the relation is – that the picture shows where the toy is right now.

Finally, the children must *use the picture as a guide* for action, that is, as a source of information about where they should search in the room. They must rely on their mental model of the depicted situation to tell them where to search for the hidden toy. Each time they see a new picture, their mental model has to be updated (Perner, 1991) to reflect the now current situation.

The intuition of most adults is that this task would be trivially simple for toddlers, even though they are unlikely to have had experience using pictures in this way. From the work on picture perception in infants, we can be confident that 24-month-olds could both identify the depicted objects and discriminate them from their real counterparts. We also would expect them to be able to make a sensible interpretation of the picture; that is, they should be able to construct a coherent mental model of a toy behind a chair. We do not know, however, whether young children would understand the specific relation that exists between the picture and reality and would rely upon the depicted information to guide their behavior.

EXPERIMENT 1

In all the studies reported here, we explored young children's understanding and use of pictures that represented a specific state of reality. In the first experiment,

24- and 30-month-old children participated in a simple object-retrieval game. On each trial, an experimenter showed the child a picture of the room, pointed to the location where the toy was hidden, and asked the child to retrieve it. To succeed in this task, the child had to extract information from the picture concerning the location of the hidden doll and use that information to guide retrieval. We reasoned that if the children were successful at finding the hidden toy, it would indicate that they understood the relation between the picture and the depicted reality and could rely on the picture as a source of information about reality (the location of the toy). Failure in this task would indicate failure to understand the picture–referent relation or to use the depicted information to guide behavior.

2. Method

2.1. Subjects

The subjects for this study were 16 children with 8 (4 males and 4 females) in each of two age groups: 24-month-olds (24–25 months, $M = 24.5$) and 30-month-olds (29–32 months, $M = 30.0$).[2] Half of the boys and half of the girls in each age group were randomly assigned to one of the two picture conditions – line drawing or wide-angle photograph. No subjects were eliminated.

In this and all the other studies reported here, names of potential subjects were obtained through birth announcements in a local newspaper, and their parents were contacted by telephone. The subjects were predominantly white and middle-class.

2.2. Materials

The same two-room suite was used for all but one of the experiments reported here. The larger of the two rooms (4.80 m × 3.98 m × 2.54 m) was furnished with a couch, a coffee table, a large armchair, a small wooden dresser, a large floor pillow, a small pillow on the couch, and a built-in set of bookcases and cupboards along one wall. The small adjoining room contained a low shelf on which the pictures were displayed.

Two different 28 cm × 36 cm pictures were used. One of the pictures was a wide-angle color photograph of the large room. The second was a lightly tinted line drawing. (It was produced by tracing over the wide-angle photograph and then lightly coloring in the appropriate shades using color pencils.) The two pictures showed the same view of approximately two-thirds of the room, and they

[2]The 30-month-olds were taken from a larger group of 30-month-olds tested by DeLoache (1991). One male and one female were randomly selected from each cell of the design.

clearly depicted all four of the items of furniture used as hiding places (see below), plus a table used for a practice trial during the orientation. The object that was hidden during the experimental trials was a small (17 cm high) stuffed dog (Snoopy).

2.3. Procedure

The entire session, which consisted of three phases – warm-up, orientation, and test – usually lasted about 25–30 min. Each child was accompanied by a parent. Two experimenters were present: one to interact with the child, the second to record his or her search behavior. During the 5–10 min warm-up phase, the primary experimenter engaged the child and parent in conversation and invited them to interact with available toys (puzzles and books).

The purpose of the orientation was to familiarize the child with the items of furniture (the hiding places) and their arrangement and to point out the correspondence between them and the picture. First, the Snoopy doll was presented to the subject. Next, the primary experimenter and subject walked around the room as the experimenter labeled each piece of furniture. The experimenter then presented the photograph or line drawing and pointed out the correspondence between the pictured pieces of furniture and their real counterparts: "This is a picture of Snoopy's room. There is his couch in the picture, and here is that couch. They're the same." The picture was held up to each piece of furniture as the correspondence was pointed out. Finally, in a further attempt to get across the correspondence between the room and the pictures, the child was given a placement trial. The experimenter said to the child, "Snoopy wants to go his room and sit right here [pointing to the table in the picture]. You take him and help him sit there." The children were able to place the toy as indicated in the picture: the older and younger groups correctly put the toy on the table 100% and 75% of the time, respectively.

The test phase immediately followed the placement trial. In included a set of four hiding/retrieval trials with a different hiding place used for each. The hiding locations were under the couch pillow, behind the chair, behind the dresser, and under the floor pillow. There were two orders of hiding places, and half the children in each picture condition received one order and half the other. On each trial, the experimenter hid the doll in a new location, pointed to that location in the picture, and asked the child to retrieve the toy. Thus, the child had to extract from the picture information about the current location of the toy and use it to guide his or her search.

The specific sequence for each trial was as follows. The child and experimenter were in a small control room where the picture was displayed on a shelf. The child could not see the picture and the larger room at the same time. The experimenter

explained to the child on each trial, "I'm going to hide Snoopy in his room, and when I come back you can go and find him." The child stayed in the small room while the experimenter concealed the toy in the appropriate hiding place in the larger room. The experimenter returned and pointed to the appropriate location in the picture, saying, "This is where Snoopy is hiding in his room; can you find him?" If the subject failed to find the doll on his or her first search, the experimenter prompted the child by saying, "Snoopy's hiding in the same place as I pointed to in the picture." If the subject failed to find the doll on the second search, the experimenter delivered a set of increasingly explicit prompts until the doll was found. The child, holding the doll, was then led back into the small room to begin the next trial.

In this and the following studies, preliminary analyses indicated that gender was not involved in any significant effects, so this variable was not included in the analyses.

3. Results and discussion

Although all the subjects were cooperative and most of them enthusiastic about the game, the two age groups differed dramatically in how successfully they used the information in the pictures to find the hidden toy. The 30-month-olds used the picture of the room to guide their search efforts, but the 24-month-olds did not.

Figure 1 shows the level of errorless retrievals for the two age groups. To count as an errorless retrieval, the subject's first search on a trial had to be correct and unprompted. The mean level of errorless retrievals was 72% for the 30-month-olds, but only 13% for the 24-month-olds. The 13% score for the younger group was wholly attributable to one of the eight subjects; this child found the toy on

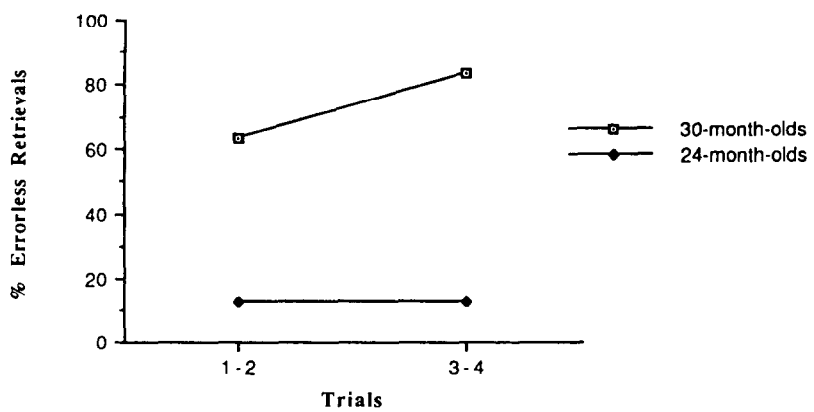

Figure 1. *Percentage errorless retrievals as a function of age and trial blocks (Experiment 1).*

every trial. The other seven 24-month-olds *never* had an errorless retrieval. Most of the eight older subjects seemed to understand the picture–room relation, in that six of them found the toy on at least three of the four trials. The difference between the groups was apparent as early as the first trial, on which five of the eight 30-month-olds went directly to the appropriate location, in comparison to only one of the younger children. (Four of the 24-month-olds searched in the wrong location, and three did not search at all.) As the trials continued, the younger subjects searched more often, but with no greater success.

The data (number of errorless retrievals) were analyzed in a 2 (age) × 2 (picture type: photograph vs. line drawing) × 2 (trial blocks: trials 1–2 vs. 3–4) mixed ANOVA, with trial blocks as the within-subjects variable. The main effect for age was the only significant effect, $F(1, 12) = 10.94$, $p < .01$.

Performance did not differ for the two pictures: 47% for the wide-angle photograph and 38% for the line drawing. There was no main effect for trials, nor did it enter into any interactions. The 30-month-olds were almost as good at the beginning as they were at the end. The 24-month-olds were equally poor throughout; they showed no improvement over trials.

The results thus show that the 30-month-olds used the information in the pictures to find the toy, updating their belief about the location of the toy based on the depicted information. The retrieval performance of the 24-month-olds, on the other hand, gave no evidence they made any connection between the room and the picture of the room. Their extremely poor performance was somewhat surprising, given the high level of performance of the children only a few months older and given their own success on the placement trial of the orientation.

One possible explanation for the poor performance of the 24-month-olds is that they might be unable to carry out a simple command to retrieve an object, regardless of the form of the command. Perhaps our younger subjects did not understand our instruction "Can you find Snoopy" or "Go find Snoopy." If this were the case, then our data would not tell us anything about their understanding of pictures.

This possibility seemed remote, given that children as young as 14 months respond to commands to fetch familiar objects that are out of sight (Huttenlocher, 1974). Nevertheless, we thought it was important to verify that, in our situation, 24-month-olds can carry out a simple command to retrieve an object when the information is communicated through a verbal rather than a pictorial medium.

EXPERIMENT 1A

A group of eight 24-month-olds (24–25 months, $M = 24.3$) served as subjects. The same materials were used as in Experiment 1, except that a Big Bird doll was

substituted for the Snoopy doll. As before, on each of four trials, the experimenter hid the toy in the room. The difference was in how the experimenter communicated to the child the location of the hidden toy. She simply reported verbally where it was: "I put Big Bird in the basket. He's hiding in the basket. Can you find him? Remember, he's in the basket."

The children went directly to the toy 82% of the time. This result shows that 24-month-olds are capable of carrying out verbal commands to retrieve a hidden object. They take a verbal symbol as relevant information to the location of the toy and update their mental model accordingly. Their performance is much better than when the same information is provided to them in a picture.

One interpretation of the data from Experiments 1 and 1a is that 24-month-old children have scant appreciation of the informational potential of pictures and that this appreciation emerges over the next few months. But before drawing this conclusion, it would be prudent to explore the possibility that our retrieval task underestimated their competence. There are certainly many examples of developmental research in which young children have turned out to know more or to be more skilled than they first appeared to be (cf. Brown & DeLoache, 1978; Donaldson, 1979; Gelman & Baillargeon, 1983; Siegal, 1991). Often, relatively minor changes in experimental procedures produce considerably enhanced performance. Thus, in Experiment 2, we modified our procedure in ways we thought might simplify the task for the younger group of subjects in an effort to elicit whatever pictorial understanding they might possess.

EXPERIMENT 2

In Experiment 2, a simple object-retrieval task was again used to test young children's understanding of pictures. The most important change from the first experiment was in the nature of the pictures used. There were two aspects of the pictures in the first study that we thought might have been problematic for our younger subjects. (1) Each picture depicted the entire room, including several different items of furniture, that is, several different hiding places. Perhaps 24-month-old children would find it easier to understand and use the correspondence between a single item and a picture of it. (2) The picture did not depict the hidden toy, so that to mount a search the child had to generate an image of the toy in the place pointed out by the experimenter. The younger children might have found it difficult to construct such an image. If so, their failure to retrieve the hidden toy might have had more to do with their imaginative capabilities than with their understanding of pictures.

Accordingly, in Experiment 2, the pictures showed the toy in its hiding place; in other words, on each trial the children saw a photograph depicting a single hiding place (a single piece of furniture) with the toy hidden in or behind it.

An additional change from Experiment 1 was the inclusion of six rather than four experimental trials. Even though there was no evidence of learning in the first study, we wanted to be able to observe any improvement that might occur over trials. Further, to gain a more precise view of developmental progress in young children's understanding of pictures, we included an additional age group intermediate between the 24- and 30-month-olds observed in Experiment 1.

4. Method

4.1. Subjects

The subjects for this study were a new group of 24 children, with 8 subjects (4 males and 4 females) in each of three age groups: 24-month-olds (23.5–24.5 months, $M = 24.4$), 27-month-olds (26.5–27.5 months, $M = 27.1$), and 30-month-olds (29.5–30.5 months, $M = 29.9$). Half of the boys and half of the girls in each age group were randomly assigned to one of two orders of hiding places. One additional subject was eliminated from the study due to uncooperativeness during the experimental trials.

4.2. Materials

The two rooms were used in the same way as in Experiment 1. The furnishings of the experimental room again served as hiding places for the toy. The items in the room for Experiment 2 included a couch, an armchair, a child-sized table and chair set, a wastepaper basket, a small dresser, and a set of cupboards built into one wall. The changes in the furnishings were made to create a total of six hiding places that could be photographed in a way that would reveal the hidden toy. The target toy was a small stuffed Big Bird doll (17.0 cm).

Two sets of six color photographs (8.9 cm × 12.7 cm) in standing plastic frames were used. One set of photographs was used during the orientation phase, and the second set during the test phase. Each of the photographs in the orientation set depicted one of the individual pieces of furniture in the large room: couch, small dresser, cupboard, small red chair, wastepaper basket, and armchair. In the test set, each photograph showed the Big Bird doll hidden in, under, or behind one of these objects. For example, one photograph showed Big Bird hidden behind the large chair, and another depicted Big Bird in the basket.

All of the orientation photographs showed a frontal view of the furniture. In other words, these photographs showed the object as it appeared as the child approached it. Some of the test photographs showed a different view of the object in order to reveal the hidden toy. For example, whereas the orientation

photograph depicted the front of the dresser, the corresponding test photograph showed the side of the dresser with the toy hidden behind it. Thus, the test photographs showed a view of the object that the child could see only after approaching very close to it or walking around to the side or back of it.

4.3. Procedure

The experimental session was basically the same as in Experiment 1, with warm-up, orientation, and test phases.

During the orientation, the child was introduced to the toy, the furniture, and the orientation photographs (depicting the individual items of furniture). The experimenter labeled each piece of furniture (the hiding places) and explicitly pointed out the correspondence between the orientation photos and the items they depicted, placing each photograph next to its corresponding piece of furniture. (To keep the experimental session under 30 min, the placement trial was omitted.)

The test phase included six-retrieval trials – one for each photograph in the test set. After hiding the toy on each trial, the experimenter showed the child the appropriate individual photograph and said, "This is where Big Bird is hiding in his room; can you find him?" If the subject failed to find the doll on his or her first search, the experimenter provided prompts as in Experiment 1.

5. Results and discussion

The 30- and 27-month-olds' search behavior was very different from that of the 24-month-olds; the older groups used the information in the pictures to guide their searches, whereas the 24-month-olds searched randomly. After looking at the picture of the hidden toy, the 30- and 27-month-olds most often went right to the depicted location; they found the toy 65% and 57% of the time, respectively. The 24-month-olds, on the other hand, searched in the correct location on only 6% of their trials. Most of the time, they either failed to search at all (33%), or they searched somewhere other than the pictured place (55%). Clearly, showing pictures of the toy in its hiding place did not help these 24-month-olds perform better than the same age group in Experiment 1, in which only the hiding location was depicted.

Figure 2 shows the percentage of errorless retrievals as a function of age and trial blocks. A 3 (age) × 2 (order of hiding places) × 2 (trials 1–3 vs. trials 4–6) mixed ANOVA with trials as the within-subjects factor was performed on the data. A significant main effect was found for age, $F(2, 18) = 11.18$, $p < .001$. According to a post hoc test (Newman–Keuls, $p < .05$), the errorless retrieval

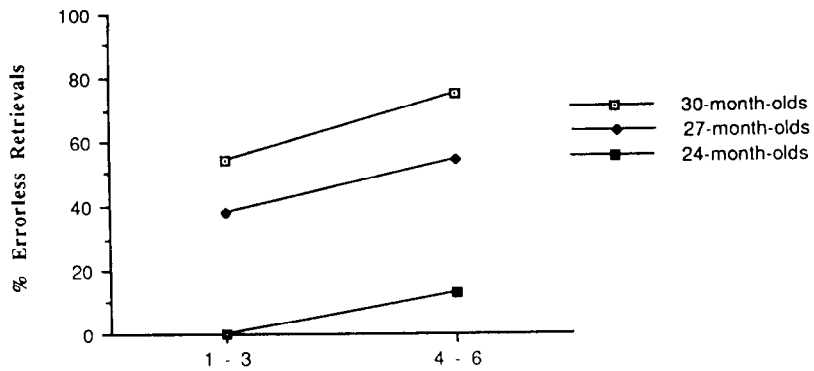

Figure 2. *Percentage errorless retrievals as a function of age and trial blocks (Experiment 2).*

score of the 24-month-olds was significantly lower than that of the two older groups, but those two did not differ from each other.

A significant main effect was also found for trial blocks, $F(1, 18) = 6.97$, $p < .05$, but no interactions. As shown in Fig. 2, the overall level of errorless retrievals increased between the first half of the trials ($M = 31\%$) and the last half ($M = 47\%$). Higher performance in the last half of the trials suggests that some children may not have related the pictures to the room at first, but gradually realized the correspondence. The 30-month-olds achieved an errorless retrieval score of 75% for the last half of the trials. Although the 24-month-olds started at zero on the first trial block and increased to 13% on the second, this increase was due solely to one child catching on to the task.

Individual performance basically mirrored the differences in average performance. Subjects were classified as successful if they found the toy without error (a) at least three times during the six trials *and* (b) at least twice during the last three trials. Seven of the eight 30-month-olds but only one of the 24-month-olds met this criterion. In the intermediate-age group (the 27-month-olds), five of the eight subjects were successful.

The error data were examined to see if the groups differed in the kind of errors they made. Error type was coded for the first incorrect search on a trial. As is usually the case in search tasks (e.g., Daehler, Bukatko, Benson, & Myers, 1976; DeLoache & Brown, 1983; Horn & Myers, 1978; Loughlin & Daehler, 1973; Perlmutter et al., 1981), the most common error (54%) for the total sample was to search in a location that had served as a hiding place on a previous trial. Most of these errors were searches of the most recent hiding place. Other types of errors were searching in a location that had not served as a hiding place on a previous trial (26%) and not searching at all before a prompt was given (20%). There was little variation among the age groups in types of errors except the "no-search" category. This was a frequent error type for the 24-month-olds

(36%) but rare for the 27- and 30-month-olds (4% and 6%). It occurred most often on the first trial.

In summary, the results of Experiment 2 are in close agreement with those of Experiment 1. Both reveal a large developmental difference in very young children's understanding of pictures. The 30-month-olds in both studies exploited the relation between the pictures and what they depicted quite successfully; the 24-month-olds did not. Although the younger children often labeled Big Bird and the other items shown in the photographs, and they actively searched for the toy, there was no evidence that the picture guided their search. After being shown the picture of Big Bird hidden in the room and being told that the real toy was hidden there, the 24-month-olds either did not search at all for the toy or, when they did search, they systematically searched other locations. Where they had last seen the real toy (on the previous trial) took precedence over the photograph they had just seen. Thus, after looking at the picture of Big Bird in the basket, they did not consider the basket a likely hiding location. It was not until they had seen the toy in the basket that they searched there – on the following trial when the toy was hidden somewhere else!

Once again, we must be cautious about concluding that 24-month-old children are as incapable of using pictures as information as appears to be the case from our first two experiments. Our task is, after all, an unfamiliar one to young children – it is fairly unusual for them to be asked to extract information from photographs and use it to guide their behavior in the real world. Accordingly, in the third study, we took great pains to explicitly familiarize a group of 24-month-old children with every element of the experimental situation. The most important feature of the orientation was to emphasize the specific relation between each experimental picture and the state of affairs it depicted.

EXPERIMENT 3

An extended orientation was designed to include several features that we thought might help 24-month-old children realize and exploit the correspondence between the pictures and the represented reality. (1) The experimenter showed the child all of the hiding locations that would be used and labeled each one. (2) With the child watching, the experimenter placed the toy in each of these locations. (3) The test photographs, each of which depicted the toy hidden in one of the locations, were also shown to the child. (4) The experimenter explicitly pointed out the relation between the picture of the hidden toy and the toy in that location. Thus, before the experimental trials began, the child had seen all of the experimental materials, had seen the toy in each of the hiding places, and had had the correspondence between each picture and its referent explicitly described.

6. Method

6.1. Subjects

The subjects for this study were 16 children. Eight (4 males and 4 females) new 24-month-old subjects (23.5–24.5 months, $M = 24.2$ months) constituted the extended-orientation group. For the standard-orientation condition, data from the eight 24-month-olds from Experiment 2 were used. Gender and order of hiding places were counterbalanced.

6.2. Materials

The room was the same as in Experiment 2, and the test set of photographs was used. (The orientation set was not used in this study.)

6.3. Procedure

The only difference from Experiment 2 was the orientation. Each child first experienced the standard orientation. Then the experimenter explained to the child, "Big Bird likes to hide, and he hides in a lot of places in his room." The experimenter and the child went to each hiding location in turn. At each one, the child watched as the experimenter placed the toy in that location, saying, "Sometimes, Big Bird hides here [behind, in] his [labeling the location]." The experimenter then showed the child the photograph that depicted the toy in that hiding location, and she explicitly pointed out the correspondence between the hidden toy and the photograph of the toy in that location. For example, the experimenter put the toy in the basket and said, "Sometimes Big Bird hides in his basket." Then she showed the appropriate picture, saying, "Look, this is a picture of Big Bird hiding in the basket. See [pointing to the toy], he's hiding just like in the picture."

The six experimental trials followed. They were conducted in exactly the same manner as in Experiment 2.

7. Results and discussion

The extended orientation seemed to affect the 24-month-olds' search behavior, in that they searched more actively than did the children who received only the standard orientation; the extended-orientation subjects failed to search without prompting only 10% of the time, whereas the comparable figure for the subjects

in Experiment 2 was 33%. Presumably, the explicit introduction to all the hiding places during the orientation delineated a set of places to look for the toy, relieving the child of the burden of generating places to search.

In spite of their enthusiasm for searching, however, the extended-orientation subjects usually looked in the wrong place. Their mean level of errorless retrievals was 16% – not much different from the level (6%) achieved by the standard-orientation subjects. The performance of these groups did not differ in a 2 (extended vs. standard orientation) × 2 (order of hiding places) × 2 (trials 1–3 vs. trials 4–6) mixed ANOVA, with trials as the within-subjects factor. Only one of the eight subjects in each group met the criterion for "successful subjects" used in Experiment 2.

The extensive orientation we provided thus had no impact. The children in the extended-orientation condition saw the photographs of the toy in each of the hiding places, watched as the experimenter placed the toy in each hiding location, and watched and listened as the experimenter explicitly pointed out the correspondence between the picture and the depicted scene. Nevertheless, their performance was essentially the same as children who had received no special instructions about the picture–referent relation.

The error data indicated that both groups' incorrect searches were most often locations that had served as a hiding place on a previous trial (55% of the errors for the extended orientation and 44% for the standard-orientation group). The errors of the extended-orientation group indicated that they seemed to remember the hiding places from the orientation; 30% of their incorrect searches were in locations that had been pointed out during the orientation but not yet used in the trials. Indeed, they almost never (3%) searched in places that had not been designated as hiding locations during the orientation. The fact that the extended-orientation subjects were familiar with and remembered the potential hiding locations makes it all the more remarkable that they did not relate the picture to the actual hidden toy in the room.

The results of the first three experiments were extremely consistent for our 24-month-old subjects: only a very few children in this age group gave any evidence of understanding the relation between the pictures and what they represented, in spite of our efforts to simplify the task and make the relation explicit and more salient. In Experiment 4, we adopted a different approach. Rather than modifying aspects of the task and the experimental stimuli, we attempted to highlight the photograph–referent relation directly. To do so, we used a Polaroid camera, demonstrating and explaining its use during the orientation. During the test trials, the experimenter went into the room, hid the doll, activated the camera, and returned with a picture that showed where the doll was hidden. We did not, of course, expect our young subjects to know or learn anything about the inner workings of cameras. We did, however, think that they might be sensitized to the picture–referent relation by watching an adult point the

camera at a particular scene and then seeing a picture of that scene emerge from the camera. The idea was to emphasize the correspondence between the real scene and the picture of it.

EXPERIMENT 4

8. Method

8.1. Subjects

The subjects for this study were 8 (4 female, 4 male) 24-month-old children (23.5–24.5 months, $M = 24.2$ months). According to their parents, only one of the children had had any exposure to a Polaroid camera. The source and general characteristics of the sample were the same as for the previous experiments. Gender and order of hiding places were counterbalanced. One additional subject was eliminated due to uncooperativeness.

8.2. Materials

The experimental rooms and furniture were the same as in Experiments 2 and 3. The photographs were Polaroid prints of the same six pieces of furniture used in the other experiments. The orientation set again showed the individual furniture items, while the test set showed the doll hidden in or behind one of them.

8.3. Procedure

Essentially the same procedures were followed as in Experiment 2, except for the use of the Polaroid camera and pictures.

The orientation phase of Experiment 4 was designed to emphasize to the children the relation between the pictures and the depicted scene. After the child was introduced to the furniture and the orientation pictures, the experimenter presented the camera and explained that she was going to take more pictures. She placed the toy on the child-sized chair and explained, "The picture will show Big Bird right on that chair." As the child watched, the experimenter snapped the camera. The flash lit up and a fully developed picture came out of the camera. The camera was rigged so a pre-taken Polaroid photograph emerged immediately after it was snapped. We did this to make sure all the children saw exactly the same photograph and to avoid having to wait the interval required for the camera

to produce a fully developed picture. The experimenter showed the picture to the child, saying, "This picture shows Big Bird on that chair [pointing out the correspondence]. That is where he is sitting." The procedure was repeated twice with two randomly selected hiding places.

On each of the six test trials, the experimenter explained to the child that she was going to go hide the doll and take a picture of it. The experimenter then left the room, hid the toy, and snapped the camera and flash. She returned with the appropriate (pre-taken) photograph and showed it to the child, saying, "This is where Big Bird is hiding right now. Can you go find him?"

9. Results and discussion

The children in the Polaroid condition were willing searchers; they failed to search on only 8% of their trials. They were not, however, competent searchers. Like the other groups of 24-month-olds, the children in Experiment 4 relied on their knowledge of the previous hiding places of the toy to guide their search, rather than the information in the photograph about its current location.

The mean level of errorless retrievals for the Polaroid group was 27% – somewhat better than the level (6%) achieved by the 24-month-olds in Experiment 2. However, the difference between the two groups was not significant in a 2 (condition: standard vs. Polaroid) × 2 (order of hiding places) × 2 (trials 1–3 vs. trials 4–6) mixed ANOVA with trials as the within-subjects factor. Two of the eight subjects in the Polaroid group met the criterion for "successful subjects" (one more than the one of eight in Experiments 2 and 3). Thus, the Polaroid procedure was as ineffective as our previous manipulations in improving our subjects' performance.

One factor that might contribute to the poor performance of the 24-month-olds in these studies is difficulty appreciating the representation of the spatial relationships depicted in the pictures.[3] Conceivably, children might interpret a picture as Big Bird and the chair, without noting the particular spatial relationship between them. If so, simplifying the spatial information in the pictures might help the younger children perform better. This was the purpose of Experiment 5.

[3]Although there are clearly many spatial aspects in our picture and model tasks, it seems unlikely that the specific spatial relationships present much of a problem to our subjects. One relevant piece of evidence is the fact that there are no consistent stimulus differences either within or across studies; that is, performance does not vary as a function of the different hiding places, in spite of the fact that different spatial relationships are involved. For example, when the toy is hidden *behind* the chair, the child must represent that particular relation. However, when the toy is hidden with the pillow, the only spatial relation that is possible is *under*.

EXPERIMENT 5

This study was just like the previous experiments, except that the pictures simply depicted the hiding place of the toy. Each color photograph showed a single item of furniture; thus there was no spatial information at all in the pictures. Subjects were presented with each picture and told that it showed where the toy was hidden.

We have used pictures such as these in previous research with 30-month-olds and found that they perform very competently with them – 70% errorless retrievals in one study (DeLoache, 1987), 84% in another (DeLoache, 1991), and 77% in a recent unpublished replication. The question here was how well 24-month-olds would do with these stimuli; specifically, would they perform better than was the case in the other picture studies reported here?

10. Method

10.1. Subjects

The subjects for this study were 8 (4 male, 4 female) 24-month-old children (23.5–25.0 months, $M = 24.2$ months).

10.2. Procedure

The materials and procedure were very similar to those of the previous studies. The main difference was that the pictures were six color photographs, each of which depicted one of the items of furniture in the room. The child was shown one photograph at a time. The experimenter pointed to the pictured object, saying, "This is where Big Bird is hiding; he's hiding [back, under] here. Can you go find him?"

11. Results and discussion

The mean level of errorless retrievals was 23%. This is no better performance than that observed for this age group in Experiments 1 and 2. Thus, reducing the amount of spatial information shown in the pictures did not improve the performance of 24-month-old children. This result suggests that difficulty ap-

preciating the spatial relationships depicted in our pictures is not a major contributor to the poor performance of this age group.

EXPERIMENT 6

The results of Experiments 1–5 paint a bleak picture of young children's understanding of the relation between pictures and what they represent – with one exception. Recall that in Experiment 1 the 24-month-olds were able to place the toy on a piece of furniture depicted in a picture, even though they were subsequently unable to retrieve the same toy when a picture showed where it was hidden in the room. This result suggests some ability to interpret the relation between a picture and its referent and to use a picture to guide action. However, since there was only a single placement trial per child, it seemed important to examine performance on multiple placement trials.

12. Method

12.1. Subjects

The subjects for Experiment 6 were 8 (4 female, 4 male) 24-month-old children (23.5–25.0 months, $M = 24.4$ months).

12.2. Procedure

The important difference between this study and the preceding ones was that the six test trials required placement rather than retrieval of the toy. On each trial, the experimenter showed the child the appropriate picture; pointing at the depicted piece of furniture, she said, "This picture shows where Big Bird wants to sit. He wants so sit right there in his room. Can you put him right there in the room?" Each of the six color photographs depicted one of the pieces of the furniture in the room. (This set of pictures was the same for the orientation in Experiment 2.) A series of prompts similar to those described for the retrieval task was given if the subject did not respond correctly; thus, on every trial, the toy ended up in the specified location.

We adopted a liberal criterion in scoring the children's placement responses: if the toy was anywhere on the specified item of furniture, the response was counted as correct. For example, putting the toy at the opposite end of the couch from where the experimenter designated on the picture would be scored as correct.

13. Results

The results for the placement task in Experiment 6 were in stark contrast to those for the retrieval tasks in the previous studies. The children were very successful in the placement task; they correctly positioned the toy 83% of the time. Thus, the performance of this group of 24-month-olds in the placement task was clearly superior to that of all the other groups of 24-month-olds in the various retrieval tasks reported here.

14. Discussion

The results of Experiment 6 establish that there is at least one case in which 24-month-olds are capable of using a picture as a guide to action. This finding is remarkable only in the context of the persistent failure of children of the same age to use pictures in the retrieval studies reported here. Why should be such a large discrepancy between children's use of pictures in the retrieval and placement tasks?

We suggest that it stems from the nature of the picture–referent relations involved in the two tasks. In the picture task, the picture denotes a particular, real object that is to be the recipient of the child's actions. The children in Experiment 6 recognized the depicted object and used that information to fill in the predicate of the placement command, "Put Big Bird [in, on] x." To do so, they presumably formed a mental model of a future, hypothetical situation (the toy sitting in or on the depicted object).

In the retrieval task, the picture represents a situation – the current reality in the room. It is about that situation. The picture specifies the target for the child's searching action only because it represents the situation of where the toy is currently hidden. To exploit the picture, the child must form a mental model of the current state of affairs in the room. Remarkably few of our 24-month-old subjects were successful in the various retrieval tasks in the first five studies; they behaved as though the information in the pictures was irrelevant to finding the toy. Their interpretation of the picture and their belief about the location of the toy in the room apparently remained separate.

Our results thus suggest that 24-month-old children can readily understand a picture as specifying the particular object that is to be the recipient of a future action, but they have great difficulty using a picture as a source of knowledge about current reality. In contrast, 30-month-olds readily accept a picture as a source of information about current reality. Most of the 30-month-olds in Experiments 1 and 2 successfully exploited the information in the pictures to direct them to the hidden toy. They were able to do so even though they had probably never been asked to use pictures in this way before. This research thus

documents a substantial change between 24 and 30 months in the flexibility of young children's interpretation and use of pictures. The pattern of performance reported here for pictures is remarkably similar to the quite rapid development that occurs, slightly later, for scale models (DeLoache, 1987).

GENERAL DISCUSSION

One obvious conclusion to be drawn from the studies reported here is that picture–referent relations are not transparent to young children, in spite of infants' precocious recognition of pictured objects. Our data thus support Sigel's (1978) dictum that picture recognition is not tantamount to comprehension, although our conclusions are based on very different tasks and much younger subjects. Thus, identification of what is depicted is only the first step to knowing how a picture is related to its referent or to being able to use a picture as a source of information.

This research has shown that very young children are quite conservative about forming a new mental model of reality based on a picture. They can readily interpret the content of the picture itself, but nevertheless fail to use it to draw an inference about the current situation. Their mental representation of the picture's content remains rigidly decontextualized, even in the face of explicit instructions and demonstrations to the contrary.

How can we account for the surprising rigidity of the 24-month-olds in this research and the flexibility of children only a few months older? To do so, we need to consider more generally the origins and early development of pictorial competence.

When an infant is shown a realistic picture of x, a variety of relevant knowledge is activated – specific knowledge about x itself, general knowledge of the category to which x belongs, other entities that x resembles, and so forth. A picture of a banana thus activates whatever the child knows about bananas – that they are edible, that they are soft and sweet, that they must be peeled. No special picture-perception abilities are required to recognize the depicted information, because so much of the invariant information that one can pick up visually from looking at the real x is also present in the picture of x (Gibson, 1971, 1980). As noted earlier, there is abundant evidence that young infants can not only transfer between two- and three-dimensional versions of the same stimulus, but they can also discriminate between them.

This discrimination of dimensionality (flatness vs. depth) does not mean that infants understand the nature of pictures. Through experience with pictures (including, for many infants, frequent and extended bouts of picture-book "reading" with parents and older siblings – DeLoache & DeMendoza, 1987; Ninio & Bruner, 1978), infants achieve two important developments: they come

to understand the peculiarities and limitations of two-dimensional objects, and they start to learn how pictures are used.

First, infants discover that pictures are not objects and that we behave differently toward them: a picture of a banana, even though it looks much like a real banana, cannot be picked up, eaten, or slipped on. It is imperative that children do not confuse external representations such as pictures with reality (Kennedy, 1974), and they learn early on not to do so. For example, in our research on infants' manual exploration of pictures, we have found that manual exploration and especially grasping attempts decline with age; these behaviors are exhibited less frequently by 15-month-olds than by 9-month-olds (DeLoache et al., research in progress).

At the same time, infants learn that there are some ways in which we behave similarly toward pictures and objects. For example, we apply the same labels to them: it is just as appropriate to say "banana" to the picture as to the real object. Pictures also serve to evoke the same thoughts, concepts and knowledge about the pictured object as the object itself. In their earliest picture-book interactions, infants experience pictures as vehicles for conversation and thought. They learn to treat pictures as objects of contemplation, rather than action (Werner & Kaplan, 1963).

In other words, infants and toddlers develop the concept "Picture". Encounters with two-dimensional stimuli now result in a two-part mental representation: a picture of x is represented as "Picture of" "x". Again, the child's knowledge about x is called to mind. However, "Picture of" signifies that part of the mental representation of x does not apply to this stimulus; specifically, all attributes having to do with its physical reality other than its visual appearance are null in this situation. Thus, perceiving a stimulus as "Picture of" "x" cancels part of the child's knowledge representation of x; it signifies that this x is decontextualized.

Our general claim is similar to those made in recent analyses of pretend play. Leslie (1987) proposed the existence of a "decoupling mechanism" whose function is to keep real and pretense representations separate. Without such a mechanism, he argued, "representational abuse" would occur – the child's pretense would merge with his or her representation of reality. Pretending a banana is a telephone would thus result in a very peculiar concept of telephones, possibly including features such as yellow and edible. In a similar vein, Harris and Kavanaugh (1993) posit mental "flags" that signal the non-literal status of pretense representations. They emphasize the necessity of keeping non-literal representations from intruding on serious ones.

The research reported in this paper suggests that young children may initially overextend their understanding that "Picture of" "x" is not the same as x. That is, they take care to keep their mental representations based on pictures from intruding into their representations of reality, even when the context invites merging them. In our research, they treat the pictures of Big Bird that we show

them as irrelevant to determining the location of the real toy in the room. Perhaps our young subjects fail to use the pictures as a source of information about reality in part because they expect pictures to be decontextualized.

One reason why very young children might err on the side of being overly conservative with respect to pictures is the fact that they typically experience pictures outside the context of their everyday activities. In their frequent picture-book interactions, parent and child remove themselves from the immediate physical context into the decontextualized content of the book.

A second reason that very young children may expect that pictures are always decontextualized is the nature of pictures themselves, as well as how pictures are used. Pictures vary in numerous ways, and there are many possible picture–referent relations, a fact that is often not acknowledged, especially in the literature on the development of picture perception and comprehension. Consider just a few such relations.

An obvious dimension on which pictures vary is pictorial medium. Some pictures are mechanically produced, such as photographs taken by a camera. Others are produced by hand, such as drawings and paintings. Adults and older children (O'Connor, Beilin, & Kose, 1981) know a great deal about the means of picture production, including the fact that a photograph has a real referent that stood before a camera at some specific time, but that other kinds of pictures might not represent real entities. Very young children are unlikely to be aware of such distinctions and unlikely to make different assumptions about the reality status of depicted referents. (For them, the main difference between photographs and other pictures would simply be the degree of physical resemblance between the picture and referent.)

Pictures also differ in their degree of realism. (For this discussion, we can ignore abstract pictures and limit our consideration to pictures with recognizable content.) Photographs are almost always highly realistic. Other pictures vary widely, from hyper-realistic, trompe l'oeil paintings to black and white line drawings of stylized shapes. We know little about how very young children respond to and interpret pictures varying on this dimension. Although it seems likely that their recognition of the pictorial content of relatively less realistic pictures would be little affected, the same might not be true of their assumptions about the relation between unrealistic pictures and their referents.

Another difference among pictures has specifically to do with the picture–referent relation. For example, a picture can depict a real referent that exists currently (as in our studies) or that has existed at some time. However, a picture can also represent objects, creatures, and events that never existed and never could exist (including philosophers' favorite non-existent entity, the unicorn).

Another very important dimension on which pictures vary is intention – the intention of the creator of the picture, its interpreter, or both, about how the picture should be interpreted and used. A highly realistic photograph can be used

to represent a specific person or event, or it can be used more generically to stand for a class of people or events. For example, a color photograph of a lamb in a field of daisies may be used to represent a real lamb at a particular time and place, or it may be used to stand for lambs in general. A color snapshot of a family in front of the Eiffel Tower might be taken with the intent to represent a particular event on a particular Paris holiday, but the same picture could be used to stand for tired and cranky tourists anywhere.

Even this very cursory examination of different kinds of pictures and different uses of pictures illustrates that understanding pictures is a greater challenge than is generally recognized. One might expect that publishers and parents might provide young children with pictures that might simplify the task somewhat for them. However, consideration of even a few children's books suggests that this is not the case.

The pictures in children's books vary from very realistic color photographs to highly simplified, schematic drawings. Although they are almost never used to represent specific people, places, or events, they are frequently used to represent reality more generally as, for example, in a baby book about farm animals. However, infants and young children also see an enormous number of pictures that are pure fantasy. For example, any examination of favorite children's books would reveal clothed animal protagonists using furniture, machines, and other artifacts (e.g., pigs building houses, a dog driving a snappy red sports car, a mother rabbit rocking her baby bunny to sleep in a conventional living room complete with fireplace and pictures on the wall, etc.).

Thus, for pictures in general and for the pictures that very young children experience in particular, there is enormous variety in the nature of the pictures themselves and in the nature of the relations between pictures and their referents. A large proportion of infants' and toddlers' experience is with pictures that do not purport to be about any reality (the primary exception being family photographs, with which some children have experience).

The developmental change that we have observed in the research reported here (between 24 and 30 months of age in our middle-class American sample) reflects an important increase in the flexibility with which children understand and use pictures. They are starting to gain some insight into the nature of picture–referent relations. They by no means have a fully fledged understanding of representation, but they have figured out that pictures are not always decontextualized; a picture can stand for a real, current situation. Having learned to treat pictures as objects of contemplation rather than action, they must now appreciate that pictures can serve in a variety of roles, including as guides to action. This flexibility is a crucial step on the path to mature symbolization.

Our research to date offers little insight into the source of this rapid development. However, we suspect that an important factor is the substantial amount of symbolization experience that children have during the third year of life (DeLoache & Marzolf, 1992). Between 24 and 30 months of age, children such as those who participated in the research reported here spend significant

amounts of time in picture-book interactions. They also engage in substantial amounts of pretend play, both solitary and joint, in which they actively create and understand symbolic substitutions. Drawing is a frequent activity for most children of this age, and their early scribbles become increasingly representational (Kellogg, 1969). Such experiences may assist children to become more flexible symbolizers, that is, to become increasingly aware of the existence of non-literal or symbolic relations among entities and to come to accept a variety of different kinds of symbol–referent relations.

In summary, we have documented a rapid developmental change between 24 and 30 months of age in middle-class children's use of pictures as information about current reality. Our research reveals that coming to understand the nature of pictures and their use is a formidable developmental task. We concur fully with Gibson (1980, p. xvii): "Most people think they know what a picture is, anything so familiar must be simple. They are wrong."

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