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Iconic realism: Understanding the relationship between photographs and reality

Pearlman, Elise Gail, Ph.D.

City University of New York, 1989

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ICONIC REALISM: UNDERSTANDING THE RELATIONSHIP BETWEEN PHOTOGRAPHS AND REALITY

by

ELISE GAIL PEARLMAN

A dissertation submitted to the
Graduate Faculty in Psychology in
partial fulfillment of the requirements
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Abstract

ICONIC REALISM: UNDERSTANDING THE RELATIONSHIP

BETWEEN PHOTOGRAPHS AND REALITY

by

Elise Gail Pearlman

Advisor: Professor Harry Beilin

This study determined whether young children go through an early stage in their understanding of reality characterized by the tendency to attribute the properties of real objects to photographs. This phenomenon is defined as iconic realism. The effects of age (3 years, 5 years), sex, representational medium (prints, slides) and representational mode (color, black and white) upon iconic realism, referent attribution, haptic behavior and justifications were tested. Sixty children at each age were randomly assigned to one of four conditions (Prints/Color, Prints/Black and White, Slides/Color, Slides/Black and White) and were asked whether the functions and physical properties of real objects are attributable to photographs and whether an action performed on a photograph or referent affects the existence of its counterpart. A parallel set of functional and physical property questions for referents was presented. Total iconic realism scores (based on all three question types) revealed that 3-year-olds were more likely to engage in iconic realism than 5-year-olds, and slides were more likely to elicit iconic realism than prints. While each question type was associated with a unique response pattern, physical property questions elicited the

most iconic realism, followed by existence and functional questions, respectively. Referent knowledge was virtually complete, although total referent scores (based on both question types) revealed that 5-year-olds performed better than 3-year-olds and girls performed better than boys. A wide variety of haptic behavior occurred in response to picture questions. Total haptic picture scores indicated that 3-year-olds were more likely to manipulate pictures than 5-year-olds, and boys were more likely to manipulate pictures than girls. Physical property questions evoked the most haptic behavior and existence questions the least.

The relationship between haptic exploration and pictorial understanding, and children's general knowledge of the photographic medium were further explored in later phases of the study. The results are interpreted in respect to the notion that pictures have a dual reality and that viewers vary in their sensitivity to information for pictures as objects in their own right (Gibson, 1971, 1980; Hagen, 1978).

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E.G.P.

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CHAPTER I : INTRODUCTION

In the last few years, a new and provocative field of inquiry has attracted the attention of developmentalists: children's understanding of photographs and the photographic process. Investigators have recently begun to explore topics such as the language used by children in describing the products of their photographic endeavors (e.g., Strandsberg & Griffith, 1969), children's understanding of the technical side of photography (e.g., Grossman, 1976; Young & Wright, 1973) and the type of subject matter which attracts the eye of the young photographer (e.g., Grady, 1970; Young & Wright, 1973). Although such studies have yielded intriguing suggestions as to how children's understanding of photographs might relate to their developing cognitive and perceptual capacities, they have shed little light on the very basic question of how photographs come to act as representations of reality. That is, is it immediately apparent to the child that objects and their photographic counterparts share only a superficial physical resemblance, with the latter merely serving as symbols of the former, or is this something that must be learned?

In contrast to the lack of attention devoted to this problem on an empirical level, the question of the nature of the relationship between picture and pictured reality has stimulated a great deal of theoretical concern, as manifested by the differing characterizations of this relationship given in the

various accounts of pictorial representation. For example, according to Gibson (1979), the relationship between picture and reality is founded on the notion that a photograph imparts the same kind of information as its corresponding real world display. Diametrically opposed is the position taken by Goodman (1968) who down-plays the notion that pictures and their referents are in any way linked by resemblance, arguing instead that pictures represent more of an arbitrary, conventionally-determined "sign" system analogous to language. Somewhere between these two extremes is the view stated most explicitly by Sigel (1978), but also shared in part by Franklin (1973) and Bühler (1930). While photographs are viewed as entailing a symbolic transformation, one which conserves meaning as well as key morphological features, this position differs from the two mentioned above in that the relationship between picture and referent does not remain stable across development. Rather, for a time, pictures function as "semi-signs" in the sense that young children operate on them as they would real objects.

While offering different conceptualizations of the relationship between picture and pictured reality, the various theories point to similar features that would seem to make photographic representation a "special" phenomenon worthy of investigation and one that might pose differential difficulty developmentally. As pointed out by Gibson (1979), Goodman (1968), Sigel (1978) and others (Franklin, 1973; Gregory, 1970; Hagen, 1978), photographs (and pictures in general) are paradoxes in the sense that while on one level they represent an object, person, or scene, they are simultaneously objects in their own

right, with their own unique textural and spatial features. As Gregory (1970) puts it: "We see both a pattern of marks on a piece of paper, with shading, brushstrokes, or photographic grain, and at the same time, we see that these compose a face, a house, or a ship on a stormy sea ... Pictures are both visibly flat and three-dimensional. They are a certain size, yet also the size of a face, house or ship" (p.32). While in accordance with Gibson and Goodman's positions, the pictorially sophisticated adults who serve as the models for their theories have no problem coping with pictures' dual reality (e.g., Gibson's photomural study where subjects were capable of estimating distance from the picture itself as well as from a tree pictured within), it is not necessarily the case that this feature of photographs poses no difficulty for children. In addition, photographs and other forms of pictorial representation differ in degree of "realism" or fidelity to their real world referents. As will be seen, realism means different things depending upon one's theoretical perspective. But as with the notion of pictures' dual nature, the developmental implications of varying amounts of realism remain. How does realism affect children's conceptualization of the relationship between picture and reality? This seems to be a particularly important question with respect to photographs, since photographs are often viewed as capturing reality more fully than other pictorial forms (Arnheim, 1974; O'Connor, Beilin, & Kose, 1979; Sontag, 1977).

Empirical Findings - Picture Perception

Although photographs and other pictorial forms have served

as stimuli in countless experiments with both humans and animals, relatively little is known about how pictures come to act as representations of reality. Instead, much research has been conducted on the seemingly tacit assumption that pictorial materials, particularly realistic forms such as photographs, are automatically "read off" and pose no difficulties of interpretation whatsoever (Beilin, 1983; Franklin, 1973; Sigel, 1971). As Sigel (1971) puts it, by operating on such an assumption, we find ourselves in the strange position of beginning our investigations "midstream": "Is it not ironic that much of what we know about cognition is based on response systems to representations? Yet we know little about the first step ... Undergirding all these response capabilities is the accepted idea that the individual has the capabilities to respond to representational stimuli" (p. 61).

Fortunately, in recent years pictorial material has become the focus of investigation in its own right. One issue that originally sparked interest was whether pictorial perception is learned or innate (e.g., Hochberg & Brooks, 1962). To illuminate this question, the following review is organized around the response to photographs of the three traditionally studied "pictorially naive" groups: infants and children, animals, and individuals from cultures having little or no exposure to pictorial materials.

Developmental Studies. Hochberg and Brooks (1962) demonstrated the ability of a 19-month-old to recognize photographs and line drawings despite previous shielding from pictorial materials. Researchers have since gone beyond this

pioneering investigation by studying pictorial recognition and differentiation of picture from referent in very young infants (e.g., Barrera & Maurer, 1981a, 1981b; DiFranco, Muir & Dodwell, 1978; Dirks & Gibson, 1977; Rose, 1977; Slater, Rose & Morison, 1984). The most widely used means of gauging the ability of such young subjects to recognize pictorial representations has been the familiarization-novelty paradigm, based on the visual preference of infants for novel stimuli (Fantz, 1956). The basic procedure entails habituation to a given stimulus (e.g., a real face), which is followed in some instances by the presentation of either a novel stimulus (a photograph of a different face) or the familiar one (a photograph of the same face), or, when the paired-comparison technique is used, by both stimuli simultaneously. In either case, greater fixation of the novel as opposed to the familiar stimulus is taken as a sign that the infant "recognizes" the subject pictured in the representation. The stimuli employed with this technique have ranged from "ecologically valid" items such as color, life-size photographs of faces (Barrera & Maurer, 1981a, 1981b; Dirks & Gibson, 1977), dolls (DeLoache, Strauss, & Maynard, 1979), and teething rings (Friedman, 1975) to black and white photographs of geometric designs (Rose, 1977). Studies employing traditional habituation procedures (i.e., a fixed number of habituation trials) place recognition of objects pictured in photographs at 5 months of age (e.g., DeLoache, Strauss, & Maynard, 1979; Dirks & Gibson, 1977). However, recognition of photographs has been demonstrated as early as 3 months of age in studies where infants controlled the

course of habituation such that the stimulus was presented until subjects themselves turned away (the "infant control technique" e.g., Barrera & Maurer, 1981a, 1981b). These findings of early pictorial recognition are supported by work on recognition memory and selective attention in infants, also employing the familiarization-novelty paradigm and photographs of human faces (e.g., Cohen, DeLoache, & Pearl, 1977; Cornell, 1974; Fagan, 1972; 1977).

While studies of pictorial recognition offer some indication of the infant's ability to see similarities between a photograph and its real world referent, investigations of the ability to differentiate pictures from their referents are informative with respect to the infant's awareness of the underlying differences between the two forms. In addition to using the familiarization-novelty paradigm (Friedman, 1975; Rose, 1977; Slater et al., 1984), investigators have studied differentiation by means of the smiling response (Polak, Emde, & Spitz, 1964) and visually guided reaching (DiFranco, Muir, & Dodwell, 1978; Dodwell, Muir & DiFranco, 1976; Rader & Stern, 1982). The age at which such differentiation emerges varies with the particular response system and test stimuli examined. DiFranco et al. (1978), testing 9- to 21-day-old infants, found that they did not differentiate, in terms of their reaching, between a graspable solid object (an orange ball against a blue background) and a color picture of the same object. Rader and Stern (1982) obtained the same findings using similar subject sample and stimuli. In contrast, at least some indication of visual differentiation between photograph and referent has been reported in newborn infants. Slater et al.

(1984) examined the ability of newborns (mean age = 2 days, 21 hours) to visually differentiate between geometric figures (circles and crosses) and their photographs. They found that newborns looked significantly longer at the objects. Other studies of visual differentiation between photograph and referent place the emergence of this ability between 3 months (Cook, Field, & Griffiths, 1978) and 6 months of age (Rose, 1977). Polak et al. (1964) found that by 3 months of age, infants discriminate in their smiles between a real face and its photographic representation.

These studies comparing the responses of infants to objects and their photographic counterparts imply that from an early age children recognize photographs as representations of reality, yet are aware that the two forms are not equivalent. Various investigations, involving tasks of a less "perceptual" nature conducted with older subjects, also seem to support the assumption that children's understanding of the representational status of photographs develops at an early age. For instance, studies have shown that children as young as three years of age experience little difficulty in matching photographs with the objects they represent (Klapper & Birch, 1969). In addition, Daehler, Perlmutter, and Myers (1976) found that 2-,2 1/2-, and 3 1/2-year-olds were able to transfer discriminations learned in relation to objects to their photographic counterparts and vice versa. Similarly, DeHaan and Wischner (1963), in comparing the ease with which two groups of retarded youngsters (with mental ages of less than 6 years) formed learning sets, one group using

objects and the other photographs, found that the two groups performed equally well. These studies demonstrating the capacity to transfer a response from object to photographs have been interpreted to mean that the young child is able to recognize the representational function of photographs.

Up to this point, the findings have been consistent in suggesting that the child's understanding of the photographic mode of representation assumes adult form at an early age. However, we will now consider a series of reports, mostly anecdotal, which suggest that the aforementioned findings may actually mask a tendency on the part of the child to confuse photographs with the objects they represent. There is some indication that even though young children will not mistake a photograph for a real object, they may make the more "subtle" error of behaving as if photographs share some of the properties of their referents. As will be seen, these findings are reminiscent of results obtained in studies of nominal realism (Osherson & Markman, 1975; Piaget, 1929) which indicate that young children experience difficulty differentiating words from their referents, and thus often wrongly behave as if words share properties of their referents.

An early reference to the tendency to attribute the properties of real objects to their photographic representations, which we will refer to as "iconic realism," occurs in Piaget's (1929) The Child's Conception of the World. In the context of a discussion of realism as manifested in children's understanding of dreams, Piaget mentions that several of his subjects seemed to believe that photographs and statues possess properties normally

attributed only to animate beings. He cites the case of a 2-year-old, who upon seeing a photograph of some women fall to the ground, began crying for fear the "ladies" had been hurt. Another child related to Piaget his belief that not only were statues and pictures alive, but that they could think and see. According to this subject, "one was not alone so long as there was a picture in the room" (Piaget, 1929, p. 103).

Another early reference to instances of "iconic realism" is Bühler's (1930) discussion of the development of pictorial appreciation. According to Bühler, once children are capable of recognizing what is represented in a picture, they pass through a stage during which they treat "pictures of objects just like the objects themselves" (Bühler, 1930, p.77). As indicative of this stage, Bühler cites the case of a child who was just as frightened of a picture of a cat as of the real cat itself, refusing to touch the cat's picture. Similarly, he noted another child's desire to touch the eyes of people in photographs in the same way that he tried to touch those of real people. Bühler had the following to say with respect to the factors that might cause a child to abandon these early beliefs and make a more "practical" distinction between picture and reality:

> In the first place the child originally grasps at any spots of light or shade on the floor and through repeated failure learns to distinguish these plane and fleeting objects of vision from the solid and unchanging ones. In the same way it will learn to manipulate sheets of paper on which pictures are drawn in a different way to real objects. (1930, p.77)

Bühler also indicated that, in addition to the role of manipulative activity, the realization that pictures have a

"representational" function contributes to an understanding of pictures as objects in their own right. Unfortunately, Bühler did not provide an explanation of what he meant by this, nor did he present any further collaborating evidence. We are also left uninformed as to the fidelity of the "pictures" in the anecdotes, and with respect to what role, if any, Bühler would assign to fidelity in understanding the relationship between picture and reality.

Scattered references to behavior suggestive of iconic realism also appear in Werner and Kaplan (1963) and Church (1961). Werner and Kaplan (1963, p. 74) cite the work of Muchow who was interested in children's perceptions of graphic objects. Muchow found that her young subjects often had a strange reaction to drawings of angular forms. For example, one 4-year-old, upon examining the pictures, exclaimed, "Ugh! What a lot of prickles and thorns," and indicated that she felt that the "thorn" might stick into her fingers if she picked up the pictures (Werner & Kaplan, 1963, p. 74).

Like Bühler, Church (1961) observed that children, upon first encountering two dimensional patterns such as designs on playpens, spots of sunlight on the floor, or stains on woodwork, may persistently attempt to pick up the patterns. Such efforts are also applied to representations in books, accompanied by attempts to pet pictured animals and listen to pictured watches. Church hypothesized about the explanation for such behavior. On one hand, Church viewed such failures to adequately distinguish between pictures and the objects they represent as a reflection of realism in the Piagetian sense, of experiencing all things as

"equally real and real in the same sense and on the same plane: pictures, words, people, things, energies, dreams, feelings" (Church, 1961, p. 15). On the other, Church interpreted such observations as supporting an early Gibsonian view (1960) that three-dimensional perception is primary, and the ability to perceive two-dimensional forms develops as cues for two-dimensionality are learnt, such as the contrast between the level of illumination "in" the picture and that of the room. Church seems to imply that observed instances of iconic realism reflect the failure on the part of the child to attend to or "pick up" cues for two-dimensionality.

Lastly, some behavior indicative of iconic realism has been reported in the context of some recent studies involving picture-book reading with very young children (e.g., Murphy, 1978; Ninio & Bruner, 1976). Murphy (1978), who was interested in the role of pointing in the context of a shared activity, tested subjects ranging in age from 9 to 24 months. She found that the younger infants "hit the pictures in the book and scratched at the pages as if trying to lift the picture from the page" (Murphy, 1978, p. 379). Murphy also commented that the older infants appeared to be "acting on the book" rather than looking at it, but unfortunately she did not provide any examples. Ninio and Bruner (1976) used joint picture-book reading as the context for an investigation of the development of lexical labels. A single child was observed interacting with his mother from the age of 8 to 18 months. Ninio and Bruner noted that pictures elicited behaviors from the child normally directed only toward objects: the child would scratch

and finger the pictured objects, run his hand across the picture surface, and try to look beneath the pages. Ninio and Bruner interpret these behaviors, which became less frequent with age, as attempts to check on the "dual nature" of pictures. That is, that pictures can be perceived as both two-dimensional objects and as three-dimensional scenes creates a conflict for the child, that is resolved by realizing the unique status of pictures as visual objects. According to Ninio and Bruner, this is achieved through motoric exploration of the properties of pictures as objects and maternal inquiries that require the child to maintain an "as if" attitude toward pictorial representations.

In conclusion, a comparison of developmental findings using photographic stimuli yields an inconsistent picture as to the status of children's understanding of photographic representation. On one hand, studies conducted with infants demonstrate differential responding to photographs and their real world referents (e.g., Polak, Emde, & Spitz, 1964), implying that from an early age, children recognize photographs as representations of reality, yet are aware that the two forms are not equivalent. On the other hand, anecdotal evidence (e.g., Bühler, 1930; Church, 1961) and findings from two observational investigations (Murphy, 1978; Ninio & Bruner, 1976) suggest that even beyond infancy children may confuse photographs with properties of their referents. Unfortunately, studies demonstrating the capacity of children to transfer responses from objects to photographic equivalents (e.g., Daehler, Perlmutter, & Myers, 1976) while seemingly supporting the claim that children's understanding of the representational nature of

photographs develops at an early age, actually do not clarify the issue because the basis for transfer is not clear: are the children transferring because of their awareness of the symbolic relationship between photograph and referent, or because on some level there is lack of differentiation or else confusion between the two forms?

In order to determine the generality of these findings, we will now examine results which have emerged from research with cultures whose exposure to pictorial materials differs from that of our own.

Cross-Cultural Studies. Like developmental investigations, research conducted with individuals from societies relatively poor in pictorial stimulation by Western standards has served as an arena for examining the role of experience in picture perception. Intrigued by reports of failures of individuals from non-western cultures to recognize objects pictured in photographs (e.g., Segall, Campbell, & Herskovits, 1966), researchers embarked on investigations of pictorial recognition and pictorial depth perception, using primarily African samples, the results of which have formed the subject of a number of recent reviews (Hagen & Jones, 1978; Jones & Hagen, 1980; Kennedy, 1974; Miller, 1973). Despite the haphazard nature of some of the research, and the variety of tasks and types of pictures used, the consensus with respect to the ability to recognize photographic representations is clear: the perception of color photographs is virtually "culture-free," and whereas the translation into shades of grey has proven somewhat more problematic for the naive

perceiver, black and white photographs are generally recognized, too. As Jones and Hagen (1980) point out, the problem that people from less pictorial cultures face is basically one of attentional deployment rather than a case of their perceiving the photograph as a random array.

Having provided evidence for the seemingly universal ability to recognize objects pictured in photographs, one may wonder whether there is any indication of the tendency to attribute the properties of real objects to photographs that has been reported for young children. Here our search is hampered by the widespread tendency on the part of researchers engaged in cross-cultural work to avoid using color photographs because they are too much like the "real thing" (Jones & Hagen, 1980). However, despite this problem and the failure of cross-cultural researchers to explicitly investigate confusion of picture and reality as an interesting question in its own right, there is some anecdotal evidence which suggests that iconic realism occurs in this context. For instance, Thomson (cited in Deregowski, 1976) showed photographs of women to members of the Wa-njemp tribe and noted that, not only were the photographs recognized, but that the natives seemed to think that the photographs were living beings. As may be recalled, similar beliefs have been reported on the part of children by Piaget (1929). There is also the suggestion that individuals from non-pictorial cultures, like children, engage in behaviors seemingly directed toward checking on the "dual nature" of pictures. Deregowski, Muldrow, and Muldrow (1972), reporting earlier work conducted with a remote Ethiopian population, observed that "when a drawing of an animal ... was

presented to the subjects, they would take the paper, feel, smell, and taste, and listen to it whilst flexing it" (p. 418), seemingly ignoring the content of the drawing itself. Deregowski et al. do not report any attempt to gauge the Ethiopians' recognition of the picture once exploration of the pictorial surface ceased. Instead, they interpret this sort of behavior as representing a reaction to paper, a foreign medium for these subjects. Consequently, in later work a familiar coarse whitish cloth was substituted for the paper. Deregowski et al. did not report attempts to explore the familiar cloth material. There is an alternative explanation, however, which remains untested since, as Hagen and Jones (1978) note, Deregowski et al. did not test a comparison group for recognition of drawings printed on paper. It is possible that the Ethiopians attempted to manipulate and explore the drawings done on paper as opposed to those on cloth because the former presented less information for the picture as an object (i.e., less surface information), prompting the subjects to check on the picture's dual nature.

The importance of the characteristics of the pictorial surface for this population has been suggested by Deregowski (1976). In contradiction to earlier reported failures of pictorially naive individuals to recognize pictures:

> given sufficiently rich pictorial cues and a decrease of ambient cues which convey the flatness of the surface on which a picture is made, such as occurs in projection of transparencies in the dark even unsophisticated ... viewers respond with vigour. (1976, p. 20)

Deregowski quotes Lloyd's (1904) anecdote concerning the projection of a slide depicting an elephant on a suspended cloth

sheet for viewing by a tribe of Africans:

> The wildest excitement immediately prevailed, many people jumping and shouting ... while those nearest to the sheet sprung up and fled. The chief himself crept stealthily forward and peeped behind the sheet ... and when he discovered that the animal's body was only the thickness of the sheet, a great roar broke the stillness of the night. (Deregowski, 1976, p. 20)

A final, although somewhat different, illustration of the tendency of members of non-pictorial cultures to confuse picture and reality is found in Deregowski et al.'s (1972) study of pictorial recognition in a remote Ethiopian population. These authors report that the mode of presentation (vertical versus horizontal) affected subjects' interpretation of pictures. For example, a picture of a buck was placed on the ground, the subjects being asked to indicate what the buck was doing. Nine respondents answered that the animal was "lying down." Immediately following this, six of these subjects were shown the same drawing, this time held vertically. All six subjects responded that the buck was "standing up." Hagen and Jones (1978), noting similar findings with children (e.g., Benson & Yonas, 1973; Hagen, 1976a), suggest that these results may be indicative of a period during the development of pictorial perception when pictorial space is not viewed as distinct from that of the real world.

In conclusion, cross-cultural work, similar to developmental research, suggests a tendency of the part of naive observers to confuse picture and reality. Unfortunately, the degree to which this occurs in non-pictorial cultures is not as clear as in developmental research due to the scanty information available, and to the fact that whereas developmental studies indicate an

ability to discriminate pictures from objects even in infancy, investigators engaged in cross-cultural work have not examined such differentiation on the part of their subjects. The data, although meager, are suggestive, however, especially the implication that the characteristics of the pictorial surface may play an important role in picture perception.

Infra-Human Studies. As in human research, photographs and other pictorial forms have been used to study perception and learning in animals on the assumption that pictures are suitable stand-ins for objects, events and features of lay-out (Cabe, 1980). Recently, however, researchers have begun to test the sensitivity of non-human subjects to information presented pictorially. As Cabe (1980) points out, such findings are of interest for several reasons. First, since humans habitually produce and use pictures while animals do not, it is possible that animals differ from humans in their ability to understand certain objects, events, or aspects of lay-out when presented pictorially, or that their understanding varies with the form of pictorial representation. Such findings are also informative with respect to the role of experience in picture perception. Lastly, from a practical standpoint we need to know whether, for animals, the equivalence relation between pictures and their referents is such that we can continue to employ pictures as convenient surrogates for aspects of our three-dimensional world.

Owing to the inability of animals to verbalize, researchers have had to devise various non-verbal indicators of their subjects' pictorial capacities. Three commonly used paradigms

include transfer of discrimination (e.g., Cabe, 1976; Hayes & Hayes, 1953; Zimmerman & Hochberg, 1970), matching to sample (e.g., Davenport & Rogers, 1971; Davenport, Rogers, & Russell, 1975), and concept formation (e.g., Herrnstein & Loveland, 1964). The species serving as subjects in these investigations have varied from primates to birds, lizards, and fish. Some typical studies and findings follow.

Working within the "generalized discrimination" paradigm, Cabe (1976) trained pigeons to discriminate between solid objects, then reversed the reinforcement contingencies, and tested for negative transfer to the original objects themselves, and various pictorial forms (i.e., black and white photographs, line drawings, and silhouettes of the objects). Evidence of transfer of discrimination, and thus recognition, was found for both photographs and silhouettes, but not for line drawings. Davenport and Rogers (1971) also obtained evidence of recognition of objects depicted in photographs, using a cross-modal matching technique. An orangutan and two chimpanzees were presented with both color and black and white photographs, their task being to choose by touch alone which of the two objects matched the picture. The results revealed that the apes performed almost as accurately as with real objects. Accuracy proved slightly higher with color as opposed to black and white photographs.

While studies such as these provide strong evidence for spontaneous, unlearned perception of photographs, there are data which suggest that the capacity of animals to process information conveyed via pictorial displays may extend beyond mere recognition. Studies such as Herrnstein and Loveland (1964),

Herrnstein, Loveland, and Cable (1976) and Lubow (1974) demonstrate capability on the part of pigeons for forming concepts based on photographic exemplars. For example, Herrnstein and Loveland's original (1964) study showed that pigeons reinforced for pecking at photographs containing humans evidenced remarkable accuracy regardless of the varied appearance of people appearing in the pictures or intervening objects such as scenery. Findings from a study of chimpanzee "problem-solving" conducted by Premack and Woodruff (1978) corroborate these results. A chimpanzee viewed a black and white videotape depicting a human confronted with various dilemmas, such as obtaining an inaccessible banana. The chimp's task was to choose which of the two color photographs illustrated a possible solution. Premack and Woodruff found that the correct photograph was almost always chosen, indicating a capacity on the part of the chimp for integrating information from "moving pictures" and still photographs, two very different forms of pictorial representation.

The findings clearly indicate that primates and avian species are capable of recognizing objects depicted in photographs. However, although these studies provide strong evidence for the seemingly "human" facility of animals in dealing with photographs, Cabe (1980) indicates that most investigations are marred by failure to rule out simple non-discriminability of object and picture, Cabe's own (1976) study being a notable exception. Thus, according to Cabe, at least for animals, "the special representational nature of pictures remains unproven"

(1980, p. 317).

We will now consider some studies treating the unlearned responses of animals to photographs, which although not as sound methodologically as those already reviewed, relate to the question of the representational status of pictures for animals. Such studies are generally concerned with the responsiveness of animals to conspecific social displays presented via photographs (e.g., Katzir, 1981; Mendelson, Haith, & Goldman, 1978; Mendelson, Haith, & Goldman-Rakic, 1982; Sackett, 1965; 1966) and motion pictures (e.g., Jenssen, 1970; Turnbough & Lloyd, 1973). The basic premise underlying such research is that if a picture evokes the response usually elicited only by the conspecific, then there is evidence for some degree of "picture-object equivalence" (Cabe, 1980).However, as both Kennedy (1974) and Cabe (1980) point out, such conclusions are problematic in that it is not clear whether such responses are triggered by the content of the picture as a whole or by some small feature. Still, as will be seen, these studies have interesting implications with respect to the level at which animals understand photographs as representations of reality.

One area in which photographs are typically used is in the investigation of the relationship between social responsiveness and early experience. Such studies (Mendelson et al., 1978; Sackett, 1965; 1966) often report that monkeys react emotionally to pictures of conspecifics and caretakers. Sackett (1965; 1966), for instance, found that infant monkeys isolated from birth showed interest upon viewing color slides of other infant monkeys, and signs of disturbance for adult monkeys exhibiting a

threatening posture. Slides depicting monkeys engaged in other activities, humans, and non-social content did not elicit such reactions. Similarly, Mendelson et al. (1978) found that infant monkeys differentially scanned pictures depicting conspecifics seemingly "looking away" as opposed to those showing monkeys looking toward the viewer. Again the researchers report the occurrence of emotional reactions such as might be expected in the presence of strange conspecifics. Marton and colleagues (cited in Cabe, 1980) note the occurrence of emotional responses and "specific motor reactions" to photographs of caretakers, conspecifics, food, and other objects.

We will conclude this review with some anecdotal evidence which suggests that at least chimpanzees confuse pictures and their referents as reportedly do children and individuals from non-pictorial cultures. Köhler (1925) presented chimpanzees with photographs of themselves and other apes, and reported behaviors on the part of the apes such as passing their hands over the surface of the pictures and repeatedly turning from the picture to the blank side. The famous Sultan, upon viewing a photograph of himself, is reported to have "greeted" the picture. Similarly, Hayes and Hayes (1953) report that their home-reared chimp, Viki, spontaneously put her head to a magazine picture of a wristwatch as if listening for "ticking." At the same time, Viki seemed to have some understanding that a picture is not its referent since she often pointed to pictures as a means of communicating her desires (e.g., for a candy bar) and did not attempt to eat the pictures. Thus, as a whole, the evidence indicates that while

animals are capable of pictorial recognition, the level at which they understand photographs as representations of reality is not clear. Although Cabe (1976) found that pigeons are able to discriminate between photographs and their referents, most researchers have not paid attention to the question of picture-referent differentiation. Thus, cross-species investigations have seemingly ignored the implications of findings suggesting that animals may attribute the properties of objects to their photographic counterparts for theories of pictorial perception.

Theories of Pictorial Representation

Having reviewed the relevant research literature, we will now consider how various theories of pictorial representation characterize the relationship between picture and reality. The approaches of Gibson (1971, 1978, 1979, 1980), Arnheim (1954, 1966, 1969, 1986), Gombrich (1960, 1982), Goodman (1968) and Sigel (1978) have been chosen as representative of the major positions on the relationship between picture and reality, with discussion centering around the following issues: (1) the dual nature of pictures (2) the particular role assigned to realism within each theory and (3) the relative ability of each approach to accomodate the empirical findings, specifically evidence concerning iconic realism.

We begin by considering the position of J.J. Gibson (1971, 1978, 1979, 1980) which developed as an outgrowth of his general position on perception. Briefly stated, Gibson's theory of "ecological optics" is based on the notion that light to the eye is structured, and therefore capable of carrying information about features of the environment. Thus, on the basis of the

richness of the information conveyed by light, perception, rather than being constructive, is conceived as a matter of "picking up" structural invariants from the optic array.

This concept of optical information as "timeless and formless" invariants forms the cornerstone of Gibson's conceptualization of the relationship between pictures and reality. Having rejected the notion that pictures are "likenesses" of their referents by virtue of being point-to-point correspondences, Gibson (1971) defines a picture as "a surface so treated that the optic array carries the same kind of information as found in the ambient arrays of the ordinary environment" (p. 31). Thus, on this view, a picture shares certain higher order correspondences with its real world counterpart, even though stimulation carried by the light is not equivalent.

This definition of what constitutes a picture encompasses pictorial forms ranging from color photographs to line drawings and caricatures, bringing us to the question of the meaning of "realism" or "fidelity" within the Gibsonian framework. As already indicated, Gibson rejected the view that a picture is faithful to its referent in the sense of being a point-to-point correspondence. In fact, Gibson (1978) takes issue with the term "representation" when used in connection with pictures, because as he points out:

> There is no such thing as a literal re-presentation of an earlier optic array ... even a photograph, a color photograph at its technological best, cannot preserve all the information at a point of observation in a natural environment. (p.231)

However, even within these limits, one can speak of certain

pictures as being more or less faithful to their referents. Thus color photographic transparencies, in addition to sharing certain higher order equivalences with their corresponding real world displays, are also very similar in terms of lower order stimulus information such as color contrasts and brightness. Conversely, at the other end of the "fidelity" spectrum, we find pictorial forms such as caricatures "where the contrasts of luminous energy are quite different and even the forms are different but where the higher order information ... is common to both arrays" (Gibson, 1971, p. 31).

A crucial question for theories of pictorial representation concerns the role of experience in picture perception. This is an issue on which the Gibsonian position has recently shifted. The traditional Gibsonian stance held that picture perception placed no special demands on the pictorially naive observer. Pictorial or "mediated" perception was viewed as a by-product of direct perception in that the ability to pick up invariants specifying real world objects was hypothesized to transfer to the pictorial domain. This view accords well with findings demonstrating the ease of pictorial recognition in infants, animals, and apictorial cultures. However, more recently, Gibson (1980) has argued that there are fundamental differences between real world "surfaces" and "marks on a surface" and the processes by which the two are perceived. Firstly, for Gibson, the meaning associated with surfaces occurring in the real world is defined in terms of "affordances". The properties afforded by different environmental surfaces are conveyed "in the course of development ... by maturation and learning taken together, by encountering the

surfaces in the habitat, without schooling" (Gibson, 1980, p.xiii). In contrast, marks on a surface or "graphs" are said to have "referential" meaning in that they stand for something other than the surface itself. Simply encountering graphs during the course of development is not sufficient for the acquisition of referential meaning. Special instruction is required, varying with the conventionalism of the graphic system under consideration. According to Gibson (1980), photographs are wholly independent of cultural convention whereas alphabetic writing is totally conventional, with drawing falling somewhere in between. Gibson (1980) also states that while both animals and humans can perceive surfaces, only the latter is capable of making and perceiving pictures on a "communicative" level. Given this notion, and recent statements concerning the acquisition of referential meaning, it is unclear how this modified Gibsonian position comes to terms with findings indicating ease of pictorial recognition in the three traditionally studied pictorially naive groups.

In both earlier (i.e., 1978) and later (1980) accounts of his theory, Gibson acknowledges the inherent duality of pictures and the resulting complexities that this introduces into the process of picture perception:

> A picture is both a surface in its own right and a display of information about something else. The viewer cannot help but see both, yet this is a paradox, for the two kinds of awareness are discrepant. (1978, p. 231)

Gibson (1978, 1980) maintains that there is information in the optic array for both the object represented in the picture and for the picture itself, and therefore true "trompe l'oeil," or

actually mistaking a picture for the real object does not occur. At the same time, however, he makes certain statements which suggest that viewers vary in their sensitivity to this information, particularly about pictures as objects in their own right. According to Gibson (1978), while the typical "picture-wise" adult can hypothetically maintain either a "naive" attitude toward pictures (i.e., picking up information only for the perception of the virtual or represented object) or a "perspective" attitude (i.e., noticing the characteristics of the picture as an object, such as medium, style, and pictorial surface), children, animals, and non-pictorial cultures are presumable sensitive only to information for the objects represented in the picture. Thus, when viewing pictures, these naive observers hypothetically perceive "whole objects" while failing to notice such appearances as the frozen perspective of the picture. Gibson's hypothesis is that learning to draw requires one to consider appearance, and therefore results in the abandonment of the naive attitude. A study conducted by Gibson verified the ability of the mature perceiver to pick up invariants specifying the duality of pictures. Adults were presented with a life-size photo-mural depicting a lawn with trees. Gibson found that his subjects could reliably estimate their distance from a tree pictured within the mural as distinguished from their distance from the picture itself. Unfortunately, Gibson did not repeat this experiment with children, despite the interesting implications given his view of the perspective attitude as a developmentally sophisticated

accomplishment.

Gibson's (1980) statement on the inherent duality of pictures, while still implying a developmental difference, evidences a change in emphasis. Rather than manifesting an "either-or" sensitivity to the represented content (the graph) or the picture as an object (the surface beneath the graph), the difference between children and adults is characterized as a difference in degree of awareness:

> The surface on which a graph is produced can be seen underneath the graph, as there is information in the optic array for both. Hence the human child has a dual awareness, of the surface and of the graph at the same time. He may not pay attention to the surface but he is dimly aware of it. (1980, p, xiii)

While Gibson indicates that adults can usually distinguish between the "pattern of a surface and the patterns on a surface" (1980, p. xii), he is again vague with respect to the course of development, and the specific factors which might cause children to become more aware of the surface on which a graph is displayed.

In summary, Gibson proposes a non-arbitrary structural relationship as linking one pictorial form (photographs) and reality, a position which we will see is challenged by those who believe that photographs are more a matter of convention. Departing from his earlier position that picture perception places no special demands on the naive viewer, Gibson (1980) now maintains that there are fundamental differences between the processes by which surfaces and marks on a surface such as pictures are perceived. Unfortunately, Gibson is vague with respect to the details of the special instruction necessary for

picture perception, stating only that the degree of schooling will vary with conventionalism of the graphic system. We will now consider theories which admit convention in different degrees, and differ from the Gibsonian perspective in attributing more complexity to the process of "understanding" pictures.

Rudolf Arnheim's (1954, 1966, 1969, 1986) approach to pictorial representation also bears the imprint of a particular position on the nature of perception. Given Arnheim's view that perception is continuous with cognition, seeing is conceptualized as a dynamic grasping of significant structural features in the form of "visual concepts." In accordance with his Gestaltist orientation, seeing varies as a function of both the nature of the perceiver and the stimulus object, with emphasis on the role of the stimulus material in this process. Thus, the structural organization of a picture, for example, is viewed as "guiding" perception in the sense of "suggesting" certain visual concepts.

Within this framework, representation entails the creation, within a particular medium, of a structural equivalent for the original perceptual concept. Arnheim has seemingly taken an intermediate position with respect to the role played by realism in pictorial representation. For Arnheim (1954), pictures are neither pure convention nor perfect illusion, but rather "equivalences" which embody characteristics of both. Pictures entail resemblance to the extent that they share significant aspects of form with their referents. On the other hand, convention is involved in the sense that styles of capturing the significant structural features vary with the culture.

Arnheim (1974) assigns a special status to photographs as

representations of reality. As a result of the mechanical action of the camera, photographs are endowed with an authenticity unrivaled in the pictorial realm. At the same time, photographs, like other pictorial forms, fall short of being perfect replicas in that certain characteristics belie their status as objects in their own right, such as the photographic grain. Contrary to common opinion, Arnheim (1966, p. 182) indicates that "where realistic tendencies prevail over tendencies toward form construction," as in photographs, this may actually interfere with the process of pictorial comprehension. That is, realism may act to obscure salient structural features and thus hinder identification. In addition, images function in three capacities: as signs, as pictures, and as symbols. According to Arnheim, the more life-like an image, the more difficult it is for the viewer to treat it as a symbol embodying abstract meaning rather than "a piece of the practical world" (Arnheim, 1969, p. 142). Thus, Arnheim makes the point that we cannot take pictorial comprehension for granted; rather, it should be viewed as a process which varies as a function of the perceiver's experience and the particular visual medium.

The inherent duality of pictures is also treated within the framework of Arnheim's theory. A picture is conceptualized as having two structural components (that belonging to the pictured content and that of the picture as an object) which fuse to form the meaning of the picture as a whole (Arnheim, 1954). While maintaining that the distinction between image and reality is always obvious, he believes that this dichotomy may be too crude

in that it fails to consider that an image may be "taken to be real in some respects, although and because, it is known to be only an image" (Arnheim, 1966, p. 154). All images are experienced to some extent as being the thing they represent, and this is true not for only children and non-pictorial cultures, but for people in general. For example, Arnheim notes that American Indians felt the shortage of bison was somehow related to the sketches made of these animals by the white explorers.

Like Arnheim, Gombrich (1960, 1969, 1972, 1982) views perception as an interpretative process rather than a passive transcription of the impinging environment. Whereas Arnheim has focused on the stimulus object and the extent to which its structure constrains our perceptual interpretations, Gombrich's emphasis has been on the "beholder's" contribution to perception. For Gombrich, seeing involves a process of visual trial and error, in which hypotheses generated on the basis of the viewer's expectations and knowledge are tested and revised against incoming stimulation. Within this framework, representational images are construed not as faithful records of visual experience, but as symbolic entities requiring "decoding." All images are to some extent ambiguous since only some features of the world can be represented, thus allowing for an almost unlimited number of possible interpretations. Thus, as in perceiving the real world, we must call upon our stored knowledge and expectations (the beholder's share) in order to choose the interpretation appropriate for a given picture.

As to the role of realism within this theory, Gombrich tends toward conventionalism. According to Gombrich, pictures,

rather than objectively mirroring reality, entail the representation of equivalences which suggest readings in terms of natural objects. Gombrich (1960), in fact, envisions the history of art as the development of a vocabulary of schemata or conventional formulas for coding nature such that an illusion of reality is given. At the same time, Gombrich (1982) emphasizes that these pictorial codes are not "fortuitous" conventions completely at odds with our perceptions of the world. Rather, certain codes "fit" better that others, and based on viewers' reactions, pictorial schemas evolve in the direction of achieving a better match with reality. Realism, on this view, is truly in the eye of the beholder since whether a representation is viewed as realistic or not depends solely on the perceiver's expectations and acquired schemata for filling in missing information. Even photographs are looked upon as "translations" within a particular code. Interestingly enough, Gombrich, like Arnheim, faults photographs as a means of communication because of the difficulty in separating the "code" from the "content."

Gombrich's most recent (1982) statements soften his original conventionalist position. Abandoning the traditional dichotomy between "nature" and "convention," he now maintains that the skills we need to read images are graded according to ease of acquisition, from those that appear to be biologically pre-programmed to those that appear purely "ad hoc." As Gombrich (1982, p. 287) concludes, "Recognizing an image is certainly a complex process and draws on many human faculties, both inborn and acquired. But without a natural starting point, we could have

never acquired that skill."

Lastly, in line with Gombrich's analysis of images as symbolic entities, he speaks of the distinction between the pictorial surface and the objects represented upon it as that between "the symbol and the information conveyed" (1969, p. 57). When we attend to the content represented, the symbol or pictorial surface becomes transparent in the sense that we are no longer aware of its properties. Thus, according to Gombrich, we see either the picture as an object or the represented content, but never the two simultaneously. He also makes a comment which has developmental implications with respect to the dual nature of pictures. According to Gombrich, children should be less subject to representational "illusion" than adults since they are less skilled "in the interpretation of paintings in terms of an imagined reality" (1960, p. 280). Thus, in contrast to adults, children may perceive pictures as flat surfaces covered with pictograms, a view at odds with Gibson's notion of the pictorial attitude as a developmentally sophisticated accomplishment.

The conventionalist position is carried to an even further extreme in Goodman's (1968) treatment of pictorial representation. Arguing against the view that language and pictorial representation symbolize in radically different ways, Goodman maintains that pictures, like language, represent conventional symbol systems bearing no structural resemblance to reality. In Goodman's terms, "A picture to represent an object must be a symbol for it, stand for it, refer to it" (1968, p. 5). Thus, denotation, rather than resemblance, forms the core of representation.

Unlike the theorists already considered, Goodman carefully distinguishes between fidelity and realism. For Goodman, fidelity is a matter of correctness in the sense that a picture is a "faithful" copy if the object possesses the properties attributed to it by the representation. In contrast, realism is more a matter of "literalness," varying with the ease with which a picture is interpreted or "read." That is, for Goodman, "realism is not a matter of a constant or absolute relationship between a picture and its object, but of a relationship between the system of representation employed in the picture and the standard system" (1968, p. 38). In other words, realism varies with the particular habits of seeing and depicting maintained by one's culture. Thus, within a given culture, a picture is viewed as realistic if it conforms with one's experience and training in such a way that the symbols seem "transparent" and interpretation occurs without awareness.

Within the framework of this theory, the fact that pictures are simultaneously two-dimensional objects and representations of three-dimensional scenes poses no problems for the perceiver. First of all, Goodman observes that normal conditions of observation preclude true trompe l'oeil. Goodman further negates the possibility that the viewer might erroneously attribute the properties of real objects to pictures:

> In looking at the most realistic picture, I seldom suppose that I can literally reach into the distance, slice the tomato, or beat the drum. Rather, I recognize the images as signs for the objects and characteristics represented - signs that work instantly and unequivocally without being confused with what they denote. (1968, p. 35)

Goodman's treatment of pictorial representation is

reminiscent of Gombrich's in its emphasis on the "variability" of vision and representation. Goodman's theory, like many theories of pictorial representation, assumes an adult perceiver, and devotes no attention to the course of development leading up to the adult state. Snyder (1980) criticizes Goodman's vague stipulations with respect to the role of experience in pictorial representation:

> Nelson Goodman has asserted that our "privileging" of realistic modes of depiction is a product of inculcation or habituation. But to attribute this privileging to familiarity does not explain the habit, the ease with which we "pick it up," or its strength. (p. 503)

The point should also be made that Goodman's arguments regarding realism are circular in the sense that while he maintains that representation and realism are a matter of habit, he admits that eventually representational habit "generates" resemblance. Thus, although it is actually a symbolic entity bearing no structural relationship to its referent, a picture comes to look like nature to the viewer. Obviously, these considerations would make it difficult, if not impossible, to unravel the contributions of convention and resemblance in the course of developing competence within a given pictorial medium. Interestingly enough, Goodman (cited in Gombrich, 1982) has also recently attempted to clarify his position on conventionalism, and the relationship between realism and representation. Goodman now denies that representation is completely a matter of convention, in accordance with Gombrich's statement that no firm dividing line exists between nature and convention. Additionally, Goodman reiterates his belief that realism and resemblance are mutually

inter-related, stressing that neither adheres to "unique or absolute standards" (cited in Gombrich, 1982, p. 284).

The last theoretical approach we will consider is Irving Sigel's (1978) theory of pictorial comprehension, which differs from those already discussed because it is explicitly developmental. For Sigel, pictures represent the outcome of a symbolic transformation which conserves meaning as well as key morphological features. He takes issue with the assumption that recognition of the content of a picture is all there is to understanding pictorial material, maintaining that there is a process of "pictorial comprehension" which goes beyond mere identification. That is, in order to comprehend a picture, one must engage in symbolic manipulations analogous to those involved in decoding written language. However, despite the common "cognitive core" underlying pictorial and linguistic comprehension, Sigel notes that each realm is unique in that each is governed by a different rule system.

On the basis of research conducted with low SES children which showed that, unlike higher SES groups, they did not classify photographs and objects in the same way (e.g., Sigel, Anderson & Shapiro, 1966), Sigel concluded that "conservation of meaning" is basic to pictorial comprehension. That is, to truly understand a picture as a representation, a child must comprehend that meaning (e.g., cat) remains constant despite variation in mode of representation (e.g., a picture of a cat or the word "cat"). Although Sigel did not provide any substantiating evidence, he further maintained that pictorial comprehension emerges as a consequence of a more general cognitive development:

the capacity to conserve quantity. Sigel believes that this concept of equivalence is also essential for coming to grips with the dual nature of pictures since the child must recognize that referent and picture share the same meaning yet differ in that the picture is an object in its own right.

Background for the Investigation

This study represented an attempt to verify the existence of iconic realism, and to determine the cognitive/perceptual factors underlying this phenomenon by manipulating information for the picture as an object. A consideration of both theoretical and empirical research suggests the following: (1) On the theoretical level, the work of Gibson (1971, 1980), Hagen (1978) and others (e.g., Haber, 1979, 1980; Kennedy, 1974) implies that while pictures have a dual reality (what Gibson refers to as information for the "graph" as opposed to information for the surface beneath the graph), it is not clear that both kinds of information are equally available to the young child. As previously indicated, Gibson (1980) maintains that adults and children differ in their awareness of these features, with the latter only "dimly aware" of the surface on which a graph is displayed. However, Gibson does not specify the factors which might cause children to become more aware of the surface beneath the graph. Clearly, experience in perceiving the real world cannot directly help the child learn about the properties of pictures as objects. This is information one must obtain from experience with photographs or other forms of pictorial representation themselves.

Kennedy (1974) and Haber (1979, 1980) similarly maintain that, during initial pictorial encounters, pictures are not looked upon as objects in their own right. Thus, according to Kennedy (1974, p. 57), the uneducated or very young "deal with the thing depicted, not the particular slant and unique viewpoint or design of the picture." Haber (1979, 1980), noticing the relative insensitivity of children to pictorial properties such as flatness, hypothesizes a stage in development during which pictures are not experienced in terms of a dual reality but rather as "windows opening into space." Thus, like Gibson, Haber proposes the possibility that "children approach pictures initially as if they were scenes and that only secondarily do they develop ways of perceiving both of the realities in pictures" (1979, p. 89). It should be noted that Haber, too, is rather vague as to the course of development culminating in pictures' dual stature. In particular, the role played by the sources of information for pictorial properties such as flatness in not clear. As Haber indicates, children must have some access to sources of flatness information since the same sources also supply them with information about depth. Yet, at the same time, children do not seem to be applying the available flatness information to pictures.

A more explicit account of the role of pictorial surface in picture perception is given by Pirenne (1970) and more recently by Hagen (1978). Pirenne, whose views are also shared by Polanyi (1970), maintains that the co-existence of depth and flatness in pictures is something to which viewers become accustomed as a result of experience, and that the pictorial surface plays a

vital part in the adjustment process. It is Pirenne's belief that a subsidiary or non-focal awareness of the picture as a flat surface is necessary for successful picture perception, enabling the observer to compensate for viewing pictures from a less than ideal station point. Unfortunately, Pirenne, too, is vague with respect to the developmental course, merely stating that awareness of the pictorial surface and consequently compensation for viewing point, develop as a function of education and experience. Hagen (1978) similarly argues that the presence of surface information, while contradicting information for three-dimensionality, acts as a cue for "tripping" the viewer into a pictorial processing mode.

(2) On the empirical level, research with children and adults on the dual reality of pictures has centered around the effects of co-existing surface and depth information on perceptual judgments of size and depth (Hagen, 1976b; Hagen, Glick, & Morse, 1973; Yonas & Hagen, 1973). The studies, which involve manipulation of awareness of the pictorial surface (e.g., comparison of performance with back-projected slides, which de-emphasize information for pictorial surface such as flatness cues, as opposed to photographic prints), suggest that children have difficulty in dealing with the two-dimensional realities of pictures and in coordinating these features with pictures' three-dimensional aspects. For example, children are more accurate in their judgments of depth with back-projected slides than with photographic prints (Hagen, 1976b). As Haber (1979) points out, these results suggest that only secondarily do children gain

expertise in dealing with both realities present in pictures. Unfortunately, since the studies focus only on the influence of co-existing depth and flatness information on complex perceptual judgments, many questions remain unanswered. First, we really do not know how the conflict between the two types of information affects perception of single pictured objects and other, less perceptual judgments. Secondly, since in these investigations, picture perception typically takes place under constrained, monocular conditions, the results cannot tell us how characteristics of the pictorial surface affect perception in the free-viewing conditions in which pictures are usually observed. Lastly, attempts to generalize from the findings of these studies to other kinds of judgments is further hampered by the fact that pictures of geometric figures were employed as stimuli rather than pictures of common objects with familiar properties.

(3) In reported instances of "iconic realism," researchers note that children frequently try to manipulate, scratch, grasp, and "look behind" pictured surfaces (e.g., Church, 1961; Ninio & Bruner, 1976), but no one has attempted to analyze the purpose behind such behavior. These behaviors may, in fact, represent attempts to obtain information for pictures as objects in their own right. As previously indicated, such behavior is also seen cross-culturally in people presented with pictures for the first time (Deregowski et al., 1972) and in animals (e.g., in a chimp, Hayes & Hayes, 1953). Thus, the argument can be made that iconic realism is a consequence of the child's attempts to come to grips with the dual reality of pictures, with the child's lack of awareness of the properties of the picture as an object resulting

in a tendency to focus on the properties of the object represented.

An earlier study (Pearlman & Beilin, 1979), concerned with the question of how 3- to 5-year-olds come to understand that the properties of pictures are distinct from those of pictured objects, found a decreasing tendency to attribute the properties of real objects to photographic prints with age. This finding was based on a series of questions about the relationship between photographs and real world referents analogous to those used in studies of nominal realism (e.g., Markman, 1979; Osherson & Markman, 1975). The present study retained the same format which consisted of the following three question types. "Functional" questions required the child to judge whether a photographic print of an object can fulfill the same function as the real object (e.g., the child was shown a picture of an ice cream cone and asked, "Can you eat this picture of an ice cream cone?"). "Existence" questions required a judgment as to whether either the photographic print or the referent would continue to exist if its counterpart were destroyed (e.g., the child was shown a glass of juice and its corresponding photograph, and asked, "If you took this juice and drank it all up, would anything happen to the juice in the picture?"). Lastly, "physical property" questions required the child to decide whether certain physical properties of an object are also shared by its photographic equivalent (e.g., the child was shown a photograph of an ice cream cone and asked, "If you touched the picture here how would the picture feel?").

As indicated earlier, Bühler (1930) and Ninio and Bruner (1976) have suggested that haptic exploration plays an important role in the process of coming to grips with the dual reality of pictures. In accordance with the anecdotes reported by these researchers and others, the Pearlman and Beilin (1979) study revealed that children frequently attempted to touch the pictures or made requests that the experimenter perform some action on either the pictures or the referents, as if to confirm their beliefs about the relationship between picture and reality. In the present investigation, such occurrences, and the children's reactions to the confirmation or disconfirmation of their expectations were systematically monitored at several points during the experiment. As in the Pearlman and Beilin study, each child was presented with a set of photographic stimuli and asked a series of questions pertaining to the tendency to attribute the properties of real objects to photographs. However, in the present study, prior to this task, the children were instructed that they could manipulate and explore the properties of the pictures while attempting to answer the questions. This new feature addressed several questions relevant to the role of haptic exploration in understanding pictures. First of all, given the freedom to manipulate and explore the properties of photographs, one can ask if children in fact exercise this option and whether such behavior varies with age and photographic condition. The possibility was also examined that certain types of questions (e.g., physical property questions) were more likely to elicit haptic exploration than others. Lastly, an examination of correlations between iconic realism scores (which

reflect the child's tendency to attribute the properties of real objects to photographs) and haptic behavior revealed the informativeness of such behavior.

The relationship between haptic exploration and pictorial understanding was also examined in a more controlled fashion during the "counter-iconic challenges." Only children whose performance during the first phase indicated a tendency to attribute the properties of real objects to photographs participated. During this phase, the child's response to information contrary to his belief in iconic realism was monitored, representing a measure of the strength of the child's belief. For example, a child who during the first phase evidenced a conviction that drinking a real glass of orange juice would cause the level of juice in the pictured glass to go down tested this belief and was asked to justify its confirmation or disconfirmation.

The present investigation also differed from its predecessor in that it examined the relationship of pictorial surface to the phenomenon of iconic realism. The importance of pictorial surface in picture perception has been stressed by Hagen (1978) and Pirenne (1970), and varying awareness of the pictorial surface has been found to have a profound effect on children's judgments of pictorial size and depth (Hagen, 1976b; Yonas & Hagen, 1973). In these studies, variation of the pictorial surface involved a comparison between photographic prints and back-projected transparencies, with the latter reducing information for pictures as objects in their own right by eliminating some of the cues for

flatness. The present investigation expanded on this work by comparing prints with a photographic medium whose effect has yet to be empirically explored: front-projected transparencies. The comparison of prints to front-projected transparencies was of interest for two reasons. First of all, the mechanics of front - projection make it an ideal vehicle for separating out the two realities contained within a photograph, the pictured content and the pictorial surface. This is possible since passing an object (such as one's hand) in front of the projector causes part or all of the image to appear on the intervening object as opposed to the screen. Secondly, whereas back-projection can be viewed as analogous to television (at least from a child's perspective) in that the image somehow magically appears on the screen, in front -projection the means by which the image is created is more evident to the viewing child. Both these factors were expected to reduce the tendency to attribute the properties of real objects to photographs, with the result that front-projected transparencies should elicit less iconic realism than their corresponding photographic prints.

In addition to varying pictorial surface, the role of color within each photographic medium was also explored. As may be recalled, the role of color in picture perception has already captured considerable empirical attention. Within the two photographic media (transparencies and prints), the stimuli for the present investigation ranged from color life-size photographs to black and white life-size representations. For the purposes of the study, the contrast between color and black and white was conceptualized as a variation in "mode" to avoid adherence to any

particular theoretical position on realism.

Lastly, a series of questions designed to probe children's experience and familiarity with the photographic medium was included, in the hope of providing a comparison between the child's verbal knowledge of photography and his applied understanding of the dual reality of pictures as revealed through his performance on the iconic realism task. The questions varied in concern from basic photographic terminology and mechanics to more abstract considerations, such as media differences.

To summarize, the study took place in three phases preceded by a pretest. The pretest acquainted the child with the task, particularly with the fact that some of the questions related to photographs while others made reference to their real world referents. Only children who were able to follow the pattern of reference indicated by the questions were retained as subjects. During the first phase, picture-referent questioning, the child was presented with a set of photographic stimuli, and asked a series of questions assessing the tendency to engage in iconic realism. The child was also asked a parallel set of questions regarding the pictures' real world referents, in order to obtain a measure of the child's familiarity with the properties and functions normally attributed to these objects in everyday life. Children whose performance during the first phase indicated a tendency to attribute the properties of real objects to photographs participated in a second phase during which they further tested their beliefs regarding the relationship between picture and reality. Finally, all the subjects were questioned

regarding their familiarity and experience with the medium of photography, yielding as indication of the range of knowledge concerning this pictorial form for this age group.

The major hypotheses were as follows:

(1) With age, there should be decreasing tendency to attribute the properties of real objects to photographic stimuli, regardless of condition.

(2) Regardless of age and photographic medium, children should be more likely to attribute the properties of real world referents to color rather than black and white photographic stimuli.

(3) In terms of the effects of varying awareness of the pictorial surface, it is predicted that photographic prints will elicit more iconic realism than front-projected transparencies regardless of mode and age.

CHAPTER II : METHOD

Design

A 2 (Representational Medium) X 2 (Representational Mode) X 2 (Age) X 2 (Sex) factorial design was employed. Each child within a given age group was randomly assigned to one of four conditions (i.e., Prints/Color, Prints/Black and White, Slides/Color, Slides/ Black and White).

Subjects

The subjects were 143 children (eighty 3-year-olds, sixty-three 5-year-olds) attending preschool and kindergarten programs in Huntington, Long Island. Of these subjects, the protocols of 23 children (twenty 3-year-olds, three 5-year-olds) were not retained for analysis. Thirteen 3-year-olds failed to pass the pretest due to linguistic and/or attentional difficulties with the task, or simple failure to follow the pattern of reference indicated by the questions. Of those passing the pretest, 10 subjects were eliminated for the following reasons. A procedural error necessitated the replacement of one 3-year-old and one 5-year-old. Another 3-year-old had to be replaced because she did not wish to participate in Phase III. Finally, seven subjects (two 5-year-olds, five 3-year-olds) had to be replaced once testing had begun because either they were unable to attend to the task or their speech was unintelligible.

Of the remaining 120 subjects whose responses constituted the data for analysis, there were sixty 3-year-olds (26 boys, 34

girls, mean age = 3.7) and sixty 5-year-olds (28 boys, 32 girls, mean age = 5.3). Information regarding the mean age, age range, and sex ratio associated with the treatment conditions appears in Table 1.

Materials

Photographic Prints ("Prints"). The following ten objects or sets of objects were photographed using a Mamiya 645 camera and Kodak VPS 120 film: an ice cream cone, a glass of orange juice, a rose in a vase, a lighted candle, a baby's rattle, a wristwatch, a crayon, a banana, a ball, and a truck. Borderless, matte-finish 8 X 10 inch (20.3 X 25.4 cm) photographic prints were made in both color and black and white. Each print was dry-mounted and sprayed to provide a uniform finish.

The resulting photographs formed two sets:

(1) Color/Life-size Prints: This set consisted of 8 X 10 inch (20.3 X 25.4 cm) color prints and closely approximated, if not matched, the real life size of the depicted objects. Copies of these photographs, trimmed to accomodate the margins of this manuscript, appear in Appendix A.

(2) Black and White/Life-size Prints: This set consisted of black and white versions of the photographs constituting set 1.

Photographic Transparencies ("Slides"). In order to duplicate the photographic prints for the "slide" conditions, the color and black and white 8 X 10 inch (20.3 X 25.4 cm) prints were photographed with a Minolta SRT 101 camera on 35mm Ecktachrome Professional film. The size of the projected image matched that of the photographic prints.

Duplicate slides and prints were made for certain stimuli

Table 1

Treatment Conditions

Treatment (Rep. Medium/Mode)	Mean Age (Years.Months)	Age Range	Sex Ratio (Males:Females)	N
Prints/Color	3.7	3.2 - 3.11	6:9	15
Prints/Black & White	3.8	3.3 - 3.11	7:8	15
Slides/Color	3.7	3.1 - 3.11	5:10	15
Slides/Black & White	3.6	3.0 - 3.11	8:7	15
Prints/Color	5.4	5.0 - 5.10	7:8	15
Prints/Black & White	5.2	5.0 - 5.5	8:7	15
Slides/Color	5.2	5.0 - 5.9	6:9	15
Slides/Black & White	5.4	5.0 - 5.11	7:8	15

and were altered for use in the phase involving challenges to the child's beliefs. For the print conditions, these stimuli consisted of photographs of the rattle, watch, and ball cut in half on the diagonal. For the slide conditions, a thick black line drawn across transparencies of the rattle, watch, and ball simulated a diagonal cut.

Other Materials. A Kodak carousel projector was used to project the slides onto a white plastic screen measuring 30 X 22 inches (76.2 X 55.9 cm). A Sony audiocassette recorder was used to record the interview sessions with the children. A rose, a rattle, a crayon, a glass of orange juice, a watch, a banana, a ball, and a truck were used as props in assessing the child's understanding of the relationship between pictures and their real world referents.

Procedure

Phase I: Picture-Referent Questioning. Each child was tested individually. Following a brief introductory chat, the child was seated at a table. The purpose of the tape-recorder was explained and its use demonstrated.

In order to acquaint the child with the task required of him, particularly with the fact that some of the questions related to photographic representations while others made reference to their real world referents, the following pretest was given. In accordance with the condition to which the child had been assigned, he was presented with either a photographic print or a projected image showing a toy truck containing two dolls, and a real truck containing one doll. The truck in the representation had a flower decal pasted on it while the real toy

had a bird decal pasted on it. The child was asked:

> Do you know what we call this? That's right, it's a picture. (or That's right, it's a truck, but it's also something else. It's a picture.) It's a picture of a truck. It's a picture of a truck like the one we have here (indicating toy). Now today I'm going to be asking you some questions about pictures. Let me show you what I mean. Can you tell me what is pasted on the truck in the picture? That's right, a flower. So to answer that question, you had to pay attention to this picture of the truck, and not this toy truck, because if you thought about this toy truck and not this picture, you would have said `bird' and that would be wrong. Let me ask you another question. How many dolls are there in the truck in the picture? That's right, two. So again to answer that question you had to think about this picture of the truck and not this toy truck.
>
> So some of the questions I will be asking you today will be about pictures, like this picture of a truck. But sometimes I won't be asking you about pictures. For example, I could ask you about this toy truck. This toy truck isn't a picture, is it? Can you tell me what is pasted on the toy truck? That's right, a bird. So to answer that question, you had to think about this toy truck and not the picture. Let me ask you another question. How many dolls are there in the toy truck? One, right? So again, you had to think about this toy truck and not the picture.
>
> Now I am going to be asking you some more questions and I want you to remember what I've just told you. Some of the questions will be about pictures like this picture of a truck and some of the questions will be about things like this toy. So I'll be asking you about two different things, about pictures and about other things like toys. So if you don't know which one I'm asking you about, be sure to tell me, okay?

If the child appeared confused, or made an error, (e.g., when asked what was painted on the truck, the child said "flower"), the experimenter supplied the correct response (i.e., "bird") and the aforementioned explanation and questions were repeated. Children who perseverated in giving "picture answers" (i.e., two dolls, flower) when asked about the toy trucks and vice versa were not retained as subjects. In addition, subjects whose speech was unintelligible or who were unable to attend to the pretest were also eliminated.

Those who passed the pretest received the following instructions regarding haptic exploration of the photographic stimuli:

> There's one more thing that I have to tell you before we start. While you're answering the questions about the pictures, there's something that you could do that might help you. You can touch the pictures, turn the pictures over, or look behind the pictures, if you think that will help answer the questions. Okay?

The experimenter was now ready to begin picture-referent questioning, the procedure for which will now be described. A fixed random order was provided for content (e.g., juice, ice cream cone, ball) such that each stimulus (e.g., ice cream cone) appeared in each position in the questioning sequence an approximately equal number of times. Within a given content, (e.g., lighted candle) picture questions alternated with referent questions, the sequence appearing first determined randomly. Once within a particular content, questioning related to pictures was completed before initiating referent questioning, and vice versa. A description of the two sets of questions follows.

Picture Questions. The following 18 questions required the child to decide if the properties of real objects could also be attributed to their photographic representations. The child was asked two questions with respect to each picture. While each picture was not paired with every question type, there was an equal number of the various combinations of two question types contained within the series. There was also an equal number of the different types of existence (Type 1 and 2) and physical property questions (the latter pertaining to the various senses). The procedure for questioning was as follows. Upon presentation

of each picture, be it photographic print or projected image, the experimenter pointed to the object of interest and asked, "What is this a picture of?" The experimenter then proceeded to ask the child questions from the following:

Ice Cream Cone

Can you eat this picture of an ice cream cone? (Functional)

If you touched the picture here (indicating ice cream), how would the picture feel? (pause) Would the picture feel cold? (Physical Property, Touch)

Juice

Can you drink this picture of juice? (Functional)

If you took this juice (indicating real juice) and drank it all up, would anything happen to the juice in the picture? (Existence, Type 1)

Rose

(S was asked to identify the object, rose, and the leaves)

If you took this rose (indicating real rose) and tore some of the leaves off, would anything happen to this picture? (Existence, Type 1)

If you got very close to this picture, how would the picture smell? (pause) Would the picture smell like a flower? (Physical Property, Smell)

Candle

(S was asked to identify the object, candle , and the flame or "fire")

Can you blow out this picture of a candle? (Functional)

If you touched the picture here (indicating flame), how would the

picture feel? (pause) Would the picture feel hot? (Physical Property, Touch)

Rattle

If you cut this picture in half, would anything happen to this rattle? (indicating referent) (Existence, Type 2)

If you shook the picture, could you hear the rattle? (Physical Property, Sound)

Watch

If you cut this picture in half, would anything happen to this watch (indicating referent)? (Existence, Type 2)

If you got very close to this picture, could you hear the watch? (Physical Property, Sound)

Crayon

Can you write with this picture of a crayon? (Functional)

If you took this crayon (indicating referent) and broke it in half, would anything happen to the picture? (Existence, Type 1)

Banana

Can you eat this picture of a banana? (Functional)

If you got very close to this picture, how would the picture smell? (pause) Would the picture smell like a banana? (Physical Property, Smell)

Ball

Can you bounce this picture of a ball? (Functional)

If you cut this picture in half, would anything happen to this ball? (indicating real ball) (Existence, Type 2)

Following each response, the child was questioned in an open-ended fashion regarding the reasons for his answers and an

attempt was made to clarify any ambiguous responses. In particular, with respect to the physical property questions, the experimenter attempted to elicit descriptive information regarding the pictures from the child before suggesting its properties. If the child responded definitively by either spontaneously attributing the property of a real object to a picture (e.g., for the photograph of the ice cream cone, if the child said, "cold" when asked, "If you touched the picture here, how would the picture feel?") or by denying that a photograph possesses the properties of real objects, (e.g., by saying "not cold"), the more specific probe (i.e., "Would the picture feel cold if you touched the picture here?") was omitted. A list of the specific "follow-up" questions relating to each stimulus appears in Appendix B. For example, with respect to whether one can eat a picture of an ice cream cone, a child who responded affirmatively was asked, "If I let you eat the picture of the ice cream cone, how would the picture taste? Would the picture taste like strawberry ice cream?"

With respect to children's pictorial manipulation, an effort was made to restrain the children from engaging in this activity until they had answered the question posed by the experimenter (e.g., "If you touched the picture here, how would the picture feel?") Once the child responded, he was allowed to freely manipulate the picture. This behavior and any comments made by the subjects regarding the outcome of their manipulation were noted (e.g., "It's not cold"). Subjects were not questioned if they failed to comment, nor did the experimenter probe for justifications.

Referent Questions. The referent questions paralleled the picture questions, with the exception of the existence questions. The latter were omitted since they dealt with the relationship between picture and referent, and therefore had no parallel when questioning was oriented strictly towards the real world domain. The objects to which the referent questions referred were present in all cases, with the exception of the lighted candle and the ice cream cone for practical reasons. As before, the child was asked to justify his answers, and ambiguous responses were clarified using modifications of follow-up questions used with the pictorial stimuli (See Appendix B) It should also be pointed out that pilot testing revealed that, due to idiosyncrasies in the lives of individual children, it was sometimes necessary to vary the form of questions slightly in order to ascertain if the child was familiar with the property or function normally attributed to the referent. For example, in the case of the ice cream cone, this sometimes meant specifying an ice cream truck as the source of ice cream instead of a candy-store. In other instances, children indicated that they were either allergic or didn't like one of the food referents when asked if they could eat it. In these cases, the child was then asked if the experimenter could eat the item in question. As in the case of pictures, attempts to manipulate objects were noted.

Ice Cream Cone

Do you like ice cream? Let's say I took you to the candy-store and I got you a strawberry ice cream cone. Could you eat that ice cream cone? (Functional)

If you touched the ice cream cone from the candy-store right on the ice cream, how would the ice cream feel? (pause) Would the ice cream feel cold? (Physical Property, Touch)

Juice

Can you drink this glass of juice? (Functional)

Rose

If you got very close to this rose, how would the rose smell? (pause) Would it smell like a flower? (Physical Property, Smell)

Candle

Have you ever been to a birthday party? They have birthday cakes there, don't they? Let's say I had a birthday cake here and there were candles on the cake, and there was fire on the candles. Could you blow out those candles? (Functional)

If you touched the fire on the candles on the birthday cake, how would the fire feel? (pause) Would the fire feel hot? (Physical Property, Touch)

Rattle

If you shook this toy, could you hear the rattle? (Physical Property, Sound)

Watch

If you got very close to this watch, could you hear the watch? (Physical Property, Sound)

Crayon

Can you write with this crayon? (Functional)

Banana

Can you eat this banana? (Functional)

If you got very close to this banana, how would the banana smell? Would it smell like a banana? (Physical Property, Smell)

Ball

Can you bounce this ball? (Functional)

Phase II: Counter-Iconic Challenges

Following picture-referent questioning the child was given a five minute "rest period" during which he played with a plastic puzzle provided by the experimenter. During this time, the experimenter determined if the subject was eligible for Phase II (i.e., exhibited iconic realism during Phase I) and set up materials for the counter-iconic challenges. Only questions to which the child responded with iconic realism during the initial phase of the questioning were challenged. The stimuli serving as the basis for the challenges came from the set of pictorial materials to which the child responded in the first phase, and were presented in random order. The form of the challenge varied with the form of the original question as follows:

(1) Functional Challenges: Challenges to the functional questions involved asking subjects to use the picture to fulfill the functions served by the real world referents. For example, with reference to the picture of the ice cream cone, the child was told: "Before you told me that you could eat this picture of an ice cream cone. Would you like to eat the picture now?" Similarly, the child was asked if he wanted to try to blow out the flame on the picture of the candle. The child's behavior was noted, with care being taken to prevent the child from going so far as to destroy the stimuli (e.g., by licking the picture). Following the child's attempt or comments to the effect that such action would prove futile, the child was asked to provide an

explanation, and was questioned in an open-ended fashion with respect to the reasons behind his remarks. If the child hesitated or failed to respond, he was told, for example: "You don't seem to want to eat this picture of an ice cream cone? Why not?" If the child still did not respond, he was asked: "Which would you rather eat, a picture of an ice cream cone, or an ice cream cone from the candy-store, or are both just as good for eating?"

(2) Existence Challenges: As before, the child's initial response was reiterated, following which the experimenter performed the act specified in the existence question. In the case of Type 1 existence questions (i.e., does destruction of the referent affect the picture?), this took the form of actually altering the state of the referent (e.g., spilling out the juice or breaking the crayon in half). The child was told, for example: "You told me that if I broke this crayon in half, the picture would break, too. Now here is the crayon and here is the picture." The picture was then hidden from the child's sight. The crayon was then broken and the experimenter said, "I just broke the crayon in two. Do you think that anything has happened to the picture of the crayon?" The picture was then shown to the child, and he was asked, "Did anything happen to the picture? Why or Why not?"

The procedure involving Type 2 existence questions (i.e., does destruction of the picture affect the referent?) differed from the above in that the child was shown a print that has already been cut in half or witnessed the projection of a slide on which a black line has been drawn to simulate a break in the picture. First the referent was hidden from the child's view, and he was told: "I just cut the picture of a rattle in half. Do you

think that anything has happened to the other rattle?" The child was then shown the intact referent, and asked, "Has anything happened to this rattle? Why or Why not?"

(3) Physical Property Challenges: The child was shown the stimulus in question and his previous response was reiterated: "Before you told me you thought the picture would feel cold if you touched the picture here. You can touch the picture now to see how the picture feels." The child was then asked: "How does the picture feel? Does the picture feel as cold as ice cream from the candy-store? Why or Why not?"

Phase III: Photographic Knowledge Questions

The final phase of the session consisted of questions designed to assess the child's familiarity and experience with the medium of photography. For subjects who exhibited iconic realism, this phase was administered following Phase II. For those subjects who did not participate in Phase II (i.e., did not exhibit iconic realism), Phase III took place following Phase I. To accomodate differences in subjects' attention spans, the third phase took place either at the end of the first session or was administered separately during a second session with the child.

The questions asked were as follows:

(1) Today we've been working with what I've been calling pictures. Do you know another name for picture? What's another word for picture?

(2) Have you ever heard of the word 'photograph' or 'photo'? If the child hadn't, he was told that another name for a picture was photograph.

(3) If someone asked you to tell them what a photograph is, what would you tell them?

(4) What are photographs made of?

(5) Where do photographs come from?

(6) What do we have to do to get photographs?

(7) Let's say you wanted a picture of me, what would you do to get it?

(8) Have you ever heard of something called a camera? What do you do with a camera?

(9) Does anyone in your family have a camera? What do they take pictures of? (Filler)

(10) After we take a picture with a camera, do we have to do anything else to get the picture?

(11) What do your parents do with the pictures after they take them?

(12) Have you ever used a camera? What did you take pictures of? (Filler)

(13) Why do you think people take pictures?

(14) Besides the pictures we talked about today, have you seen any other photographs like this? Where did you see them? (Filler)

(15) When someone takes a picture of a watch, is the watch in the picture the same as the real watch or is it different?

(16) Follow-up to Question 15: How?

(17) Do you know what a drawing is? Where do drawings come from?

(18) Is the drawing the same as a photograph?

(19) Follow-up to Question 18: (If no) How is it different?

(20) Which would look more like a truck, a drawing you made of the truck or a photograph of the truck?

(21) Follow-up to Question 20: Why?

As indicated, a number of filler items were included to stimulate dialogue. Also, with reference to question #17, if the child was unable to give any indication of the origin of drawings, questioning was discontinued. This procedure was based on pilot work indicating that the overwhelming majority of children who could not give at least some indication of the origin of drawings did not appear to understand the remaining items in the series, and did not, in fact, receive credit for these items. At the end of the testing session(s), each child was thanked for his participation and allowed to chose a small gift.

CHAPTER III : RESULTS

Interviews with the children were tape-recorded, transcribed verbatim, and analyzed as follows.

Phase I: Picture - Referent Questioning

Iconic Realism. As indicated in the method section, each child was asked a series of 18 questions (functional, existence, physical property) which probed his beliefs regarding the relationship between photographs and reality. In general, the questions were phrased so that an affirmative response indicated iconic realism. However, for certain pictures (i.e., ice cream cone, rose, banana, candle), the physical property question consisted of an open-ended probe (e.g., ice cream cone: "If you touched the picture here, how would the picture feel?") followed by a more specific probe ("Would the picture feel cold?"). If the child responded definitively on the initial probe (i.e., if the child spontaneously attributed the property of the real object e.g., "coldness" to the picture or denied that photographs possess properties of real objects, e.g., "not cold"), the more directed probe was omitted. Thus, in scoring, one point was credited for each affirmative response or spontaneous attribution of a property of a real object to a photograph. A score of 18 indicated complete belief in iconic realism as measured by this task. Pilot testing revealed that children sometimes changed their answers during questioning and for the purposes of the present investigation, when this occurred, the child's final

response was the one that was scored. Sometimes children were unable to respond either affirmatively or negatively to a question (e.g., "I don't know" or simply no response) and the number of times this occurred was recorded. In addition, on several occasions children's responses were unclear, in that they contradicted later comments made about the photographs (e.g., justifying an affirmative response by saying "it's a picture"). If further questioning failed to clarify the meaning behind the child's response, it was scored as "ambiguous." Cases in which children responded affirmatively to existence questions, yet could not specify how destroying the referent or picture would affect its counterpart, were also included within this category.

The means and standard deviations for children's total iconic realism scores appear in Table 2. The overall mean for total iconic realism scores was 2.34, with individual scores ranging from 0 to 14. The distribution of total iconic realism scores as a function of age appears in Table 3. While 5-year-olds rarely had more than four iconic responses, the total iconic realism scores of 3-year-olds were more widely distributed. A four-way analysis of variance, Representational Medium (Prints, Slides) by Mode (Color, Black & White) by Sex (Male, Female), by Age (3 Years, 5 Years), was performed on these scores. Significant main effects were found for both representational medium, F (1,104) = 3.98, p <.05, and age, F (1,104) = 28.18, p < .001. There were no other significant effects or interactions. Thus, 3-year-olds' total iconic realism scores were more than three times higher than those obtained by 5-year-olds, supporting the prediction that there is a decreasing tendency to attribute

the properties of real objects to photographs with age. As predicted, the representational medium significantly influenced children's tendency to engage in iconic realism, although the effect turned out to be in the opposite direction from what was originally anticipated. That is, instead of prints eliciting more iconic realism than slides, it was found that children were significantly more likely to engage in iconic realism when viewing slides as opposed to prints. Although it was also expected that the mode of the pictorial stimuli (i.e., black and white or color) would significantly influence iconic realism scores, this did not turn out to be the case. As seen in Table 3, color and black and white pictures elicited almost identical amounts of iconic realism.

There were three different types of questions pertaining to iconic realism: functional, existence and physical property questions. Subjects' total iconic realism scores were broken down into subscores associated with the different question types, (Table 2) and three additional four-way analyses of variance were performed. The effect of age proved significant in all three ANOVAS, substantiating the overall trend for iconic realism to decline with age. The question types differed in the extent to which they were influenced by age, with physical property questions, F (1,104) = 23.44, p <.001, most significantly affected, followed by existence, F (1,104) = 11.72, p <.001, and functional questions, F (1,104) = 4.00, p <.05, respectively.

No other effects or interactions were significant with respect to physical property subscores. In terms of functional

Table 2

Means and Standard Deviations of Total Iconic Realism Scores and Subscores

for Representational Medium x Mode x Age x Sex Conditions

	Rep. Medium		Mode		Age		Sex	
	Prints (n=60)	*Slides* (n=60)	Color (n=60)	Black & White (n=60)	3 Years (n=60)	5 Years (n=60)	Males (n=54)	Females (n=66)
Total Iconic Realism Score								
Mean	1.87	2.82	2.35	2.33	3.60	1.08	2.15	2.50
SD	2.31	3.26	2.92	2.81	3.18	1.75	2.86	2.86
Functional Subscore								
Mean	.22	.22	.18	.25	.33	.10	.19	.24
SD	.67	.61	.54	.73	.77	.44	.48	.75
Existence Subscore								
Mean	.15	.83	.58	.40	.88	.10	.48	.50
SD	.58	1.74	1.46	1.20	1.73	.54	1.37	1.32
Physical Property Subscore								
Mean	1.50	1.76	1.58	1.68	2.38	.88	1.48	1.76
SD	1.70	1.93	1.82	1.83	1.79	1.52	1.65	1.95

Note. For total iconic realism score, maximum score = 18. For subscores, maximum score = 6. The means and standard deviations for "I don't know" and ambiguous responses were .10 (SD = .40) and .32 (SD = .86), respectively.

Table 3

Number of Subjects Having One or More Iconic Responses as a Function of Age

Number of Iconic Responses	3-Year-Olds	5-Year-Olds
1	8	4
2	11	2
3	7	9
4	7	3
5	3	1
6	5	1
7	3	1
8	2	0
9	1	0
10	1	0
11	2	0
12	0	0
13	0	0
14	1	0
Total	51	21

Note. In the sample (N =120), 72 children (60%) had one or more iconic responses.

subscores, the only other relevant finding was a representational medium x sex x age interaction which approached significance, F (1,104) = 3.21, p <.10.

The findings on existence questions differed from those of the other two question types in that, in addition to the effect of age, there was also a significant main effect associated with representational medium, F (1,104) = 8.92 p < .01 and a significant age x representational medium interaction, F (1,104) = 4.28 p <.05. The main effect of representational medium indicated that, in responding to existence questions, subjects were more likely to engage in iconic realism when presented with slides as opposed to photographic prints. The significant age x representational medium interaction is illustrated in Table 4. As can be seen, while both 3-year-olds and 5-year-olds were more likely to respond iconically to existence questions when viewing slides as opposed to photographic prints, 3-year-olds in the slide condition had the highest mean existence scores. Scheffé pair-wise comparisons revealed that the means obtained by 3-year-old/slide subjects differed significantly from those of two other groups (5-year-olds/slides and 3-year-olds/prints) at the .05 level, and from the remaining group (5-year-olds/prints) at the .01 level. These three groups did not differ significantly from each other.

While the preceding findings were concerned with effects within individual question types on the tendency to engage in iconic realism, the next group of analyses deals with comparison across question types. The mean iconic realism scores associated with each question type appear at the top of Table 5. As can be

Table 4

Mean Existence Iconic Subscores by

Representational Medium and Age

	Representational Medium		
Age	Prints	Slides	Total
3 Years	.30	1.47	.88
5 Years	.00	.20	.10
Total	.15	.83	

Note. N = 120.

seen, physical property questions elicited the most iconic realism, followed by existence and functional questions, respectively. Correlated t-tests performed on these mean scores indicated that the differences between functional and physical property subscores, and between physical property and existence subscores were both significant at the .001 level. The remaining comparison between functional and existence subscores was significant at the .05 level. Correlated t-tests performed separately for the two age groups revealed that these findings held true for 3-year-olds and 5-year-olds with the exception that at the 5-year-old level, the comparison between iconic functional and existence subscores did not prove significant since the mean scores were identical.

To summarize, children's total iconic realism scores were found to vary significantly as a function of both age and representational medium, with 3-year-olds achieving higher scores than 5-year-olds, and slides eliciting more iconic realism than prints. Analysis of the amount of iconic realism elicited by the various question types (functional, existence, physical property) supported the overall trend for iconic realism to decline with age. Only the existence questions were affected by the representational medium, revealing that existence questions alone were responsible for the effect of representational medium seen on total iconic realism scores. There was also a significant age x representational medium interaction associated with existence subscores. Interpretation of the findings revealed that although both 3-year-olds and 5-year-olds were more likely to engage in iconic realism upon viewing slides as opposed to prints, the

Table 5

Means and Standard Deviations of Iconic, Referent, and Haptic Picture Scores by Question Type

	Functional	Existence	Physical Property
Iconic Scores			
Mean	.22	.49	1.63
SD	.64	1.34	1.81
Range	0-4	0-6	0-6
Referent Scores			
Mean	5.94	--	5.70
SD	.24	--	.62
Range	5-6	--	3-6
Haptic Picture Scores			
Mean	.78	.18	1.96
SD	1.24	.52	1.76
Range	0-6	0-3	0-6

Note. N = 120.

difference between the two representational media was greatest for the 3-year-olds. Finally, comparison across question types,irrespective of medium, revealed that physical property questions elicited the most iconic realism, followed by existence and functional questions, respectively. As will be seen, these differential response patterns on the picture task relate, in part, to differences in the extent to which various question types elicit haptic behavior.

Referent Scores. Referent scores were based on a parallel set of questions regarding the functions and properties associated with the pictures' real world referents. The child was credited one point every time he correctly attributed a property or a function to a referent, with 12 constituting a perfect score. Again, the number of "I don't knows" and ambiguous responses were recorded (Means: Table 6).

The means and standard deviations for total referent scores are presented in Table 6. The overall mean for total referent scores was 11.64, with individual scores ranging from 9 to 12. A four-way analysis of variance, Representational Medium (Prints, Slides) x Mode (Color, Black & White) x Sex (Male, Female) x Age (3 Years, 5 Years), performed on the total referent scores, yielded the following results. Age had a significant effect, F (1, 104) = 5.59, $p < .05$, as did sex, F (1, 104) = 4.68, $p < .05$. There was also a significant sex x age interaction, F (1, 104) = 7.88, $p < .01$. There were no other significant effects or interactions. Thus, although total referent scores were high, departing from the maximum score only slightly, 5-year-olds performed somewhat better than their 3-year-old counterparts, and

girls achieved slightly higher scores than boys. The significant age x sex interaction associated with the total referent scores is illustrated in Table 7. As can be seen, total referent scores increased with age for males, but not for females, whose knowledge of real objects as measured by this task appears to have been as complete for 3-year-olds as it was for 5-year-olds. Likewise, sex differences in total referent scores appeared only at the 3-year-old level. Scheffé post-hoc comparisons of the means treated by this interaction revealed that the total referent scores of 3-year-old males differed significantly from those of 5-year-old males and 3-year-old females at the .05 level, with the comparison between 3-year-old males and 5-year-old females just missing significance at this level. Five-year-old males, 3-year-old females, and 5-year-old females did not differ significantly from each other in this regard.

As with total iconic realism scores, total referent scores were partitioned into subscores, each having a maximum total of 6. The means and standard deviations for these subscores are presented in Table 6. Additional four-way analyses of variance were performed, yielding the following results. In terms of referent functional subscores, there was very little deviation from the maximum of 6, with the result that there were no significant effects or interactions. In contrast, subscores associated with the physical property questions were somewhat lower, and analysis revealed a significant main effect of both age and sex, F (1, 104) = 5.33, $p < .05$ and F (1, 104) = 8.04, $p < .01$, respectively. There was also a significant age x sex

Table 6

Means and Standard Deviations of Total Referent Scores and Subscores

for Representational Medium x Mode x Age x Sex Conditions

	Rep. Medium		Mode		Age		Sex	
	Prints (n=60)	Slides (n=60)	Color (n=60)	Black & White (n=60)	3 Years (n=60)	5 Years (n=60)	Males (n=54)	Females (n=66)
Total Referent Score								
Mean	11.62	11.67	11.63	11.65	11.50	11.78	11.50	11.76
SD	.67	.75	.78	.63	.83	.52	.88	.50
Functional Subscore								
Mean	5.95	5.93	5.92	5.97	5.92	5.97	5.96	5.83
SD	.22	.25	.28	.18	.28	.18	.19	.27
Physical Property Subscore								
Mean	5.67	5.73	5.72	5.68	5.58	5.82	5.54	5.83
SD	.60	.63	.64	.60	.74	.43	.79	.38

Note. For total referent score, maximum score = 12. For subscores, maximum score = 6. The means and standard deviations for "I don't know" and ambiguous responses were .09 (SD = .32) and .02 (SD = .18), respectively.

Table 7

Mean Total Referent Scores by

Age and Sex

	Sex		
Age	Males	Females	Total
3 Years	11.15	11.76	11.50
5 Years	11.82	11.75	11.78
Total	11.50	11.76	

Note. N = 120.

interaction, F (1, 104) = 8.97, p <.01. Thus, when asked to attribute physical properties to real objects, 5-year-olds achieved slightly higher scores than 3-year-olds, and girls performed somewhat better than boys. The significant age x sex interaction associated with referent physical property subscores is illustrated in Table 8. As with total referent scores, referent physical property subscores increased with age for males, but not for females, whose knowledge of the physical properties of real objects as measured by this task appears to have been as complete for 3-year olds as it was for 5-year-olds. Again, sex differences in performance appeared only at the 3-year-old level. Scheffé post-hoc comparisons of the means treated by this interaction revealed that the referent physical property subscores obtained by 3-year-old males differed significantly from the other three groups at the .05 level, which did not differ significantly from each other. Lastly, physical property referent subscores evidenced a four-way interaction, (Representational Medium x Mode x Sex x Age) which approached significance, F (1,104) = 3.90, p < .10.

Finally, as can be seen in Table 5, comparison across question types revealed that functional questions were more apt to be answered correctly than physical property questions. Correlated t-tests comparing these two referent subscores indicated that they differed from each other at the .001 level. Correlated t-tests performed separately for 3-year-olds and 5-year-olds indicated that these results held true regardless of age.

To summarize, children's knowledge of the properties and

Table 8

Mean Physical Property Referent Subscores by Age and Sex

	Sex		
Age	Males	Females	Total
3 Years	5.23	5.85	5.58
5 Years	5.82	5.81	5.82
Total	5.54	5.83	

Note. N = 120.

functions of real objects was found to be relatively complete, with only slight deviations from perfect scores occurring. Age and sex were both significant factors in the analysis of total referent scores, with 5-year-olds achieving somewhat higher total referent scores than 3-year-olds, and girls performing at a slightly higher level than boys. However, examination of the significant age x sex interaction revealed that these general findings based on the main effects actually masked more complex relationships existing between age, sex, and children's total referent scores. As shown by the interaction, total referent scores increased with age for males, but not for females, and the sexes exhibited differential performance only at the 3-year-old level. The same pattern of results was found for physical property referent questions, suggesting that this subscore is responsible for the significant effects and interaction seen in the analysis of total referent scores. Finally, comparison across question types suggested that functional questions were easier for children, in that these questions more frequently received correct responses than physical property questions. These findings correspond to performance on the picture task where functional questions proved "easiest" in that they were least likely to elicit iconic realism and physical property questions were most difficult in that they were most likely to evoke this tendency. The relationship between referent knowledge and the tendency to engage in iconic realism is examined in further detail in the section dealing with intercorrelations between dependent measures.

Haptic Behavior. The following classification system was

derived from a list of haptic and related motoric behaviors observed in 168 children who served as pilot subjects for this study, and on the basis of the videotaped performance of five additional pilot subjects. The resulting categories were then consolidated and revised upon examination of a sample of behavioral data from the present investigation. The five major categories of haptic behavior and their descriptions follow:

1. Behavior Directed Towards Pictures

(a) Specific Touching. Using usually one finger, the child touched a specific place on the print or the screen, such as the flame on the candle or the ice cream on the cone. This category also included variations, such as touching the "flame" and examing one's finger, or touching the ice cream and tasting one's finger.

(b) Exploring Surface. This category consisted of behaviors such as running fingers across, rubbing, or scratching the surface of the photograph.

(c) Attempts to "Pick out" Objects. Using a "pincer" motion, the child attempted to pick an object out of a picture.

(d) Turning Over or Looking Behind. The child looked behind the screen on which the slide was projected or turned over the photographic print to examine the back.

(e) Shaking. The child shook the photographic print, or the screen on which the slide was projected.

(f) Listening. This consisted of placing one's ear to the surface of the photograph.

(g) Blowing. The child blew on the print or the

screen on which the slide was projected.

(h) Smelling. The child placed his nose to the surface of the photograph, and may have audibly "sniffed."

(i) Kissing. This involved placing one's lips to the surface of the print or screen.

(j) Exploring Circumference. Using usually one finger, the child traced all or part of the circumference of the photograph.

(k) Bouncing. This consisted of throwing the picture against a table top in an attempt to "bounce" the photograph. In actual practice, the behavior was only applied to prints.

(l) Blocking Light. In an attempt to alter the projected image, the subject placed his hands in front of the slide projector, interrupting the light source. This category was applicable only to slides.

2. Behavior Directed Towards Objects.

(a) Smelling. The child placed his nose to and may have audibly "sniffed" some real world referent (e.g., the banana or the rose).

(b) Listening. The subject placed his ear to the real object, such as the watch.

(c) Bouncing. The child bounced the real ball.

(d) Shaking. The child shook some real world referent, usually the rattle.

(e) Drawing. This consisted of the use of the crayon by the child.

3. Anticipatory Movements.

This category encompassed action, such as listening, smelling, or touching, that was initiated, but not complete in form (e.g., extending one's finger to touch the photograph, but withdrawing before contacting the surface; smelling a photograph from a distance).

(a) Towards Pictures.

(b) Towards Objects.

4. "Misplaced" Manipulation. Instances where, during questioning about the photograph, the child manipulated the referent or vice versa.

5. No Referent Present. Here the manipulation was performed in the absence of a referent (e.g., blowing when questioned about a candle on a real birthday cake).

In scoring, the child was credited with one point for each behavior that occurred within the context of picture-referent questioning. Gestures whereby the child indicated reference to either the picture and/or object were not considered. In the case of blocking the light from the projector, children sometimes engaged in this behavior out of the context of picture-referent questioning (e.g., before or after the experimenter showed the slides), and therefore the blocking behavior was not associated with any particular picture. In these cases, although the child was not credited for the behavior in question, its occurrence was recorded. As a reliability check, an independent rater viewed and re-scored the videotaped performances of 13 subjects. These came from a pool of 17 videotapes, one of which was used to train the independent rater and the remaining three which were too dark for viewing. The percentage of agreement between the experimenter and

the rater was 92%.

The means, standard deviations, and ranges associated with the various categories of haptic behavior appear in Table 9. Based on performance in categories pertaining to "behavior directed towards pictures" (See Table 9), each child was assigned a total haptic picture score. The means and standard deviations associated with total haptic picture scores appear in Table 10. The overall mean for total haptic picture scores was 2.92, with individual scores ranging from 0 to 12. A four-way analysis of variance, Representational Medium (Prints, Slides) x Mode (Color, Black and White) x Sex (Male, Female) x Age (3 Years, 5 Years), was performed on these total haptic picture scores. Significant main effects were found for age, F (1, 104) = 7.74, $p < .01$ and sex, F (1, 104) = 12.12, $p < .001$. There was also a significant representational medium x sex x age interaction, F (1, 104) = 6.77, $p < .05$. There were no other significant effects or interactions. Three-year-olds were significantly more likely to manipulate pictures than 5-year-olds, and males were more apt to manipulate pictures than females. The significant representational medium x age x sex interaction is illustrated in Table 11. While on the whole, 3-year-olds engaged in more pictorial manipulation than 5-year-olds, within a given age group, the tendency to motorically explore pictures varied according to both sex and representational medium. Thus, among 3-year-olds, males in the photographic print condition exhibited the most manipulation whereas among the 5-year-olds, it was the males in the slide condition who achieved the highest haptic

Table 9

Means, Standard Deviations and Ranges of Categories and Subcategories of Haptic Behavior

(page 1 of 2)

	Mean	SD	Range
Behavior Directed Towards Pictures (Total)	2.92	2.93	0-12
Specific Touching	1.27	1.31	0-10
Exploring Surface	.28	.70	0-5
Attempts to "Pick Out" Objects	.15	.56	0-4
Turning Over/Looking Behind	.13	.43	0-2
Shaking	.16	.37	0-1
Listening	.14	.35	0-1
Blowing	.22	.41	0-1
Smelling	.37	.63	0-3
Kissing	.02	.13	0-1
Exploring Circumference	.08	.30	0-2
Bouncing	.02	.13	0-1
Blocking Light[a]	.09	.32	0-2

Table 9 (*Continued*)

(page 2 of 2)

	Mean	SD	Range
Behavior Directed Towards Objects (Total)	.90	1.24	0-5
Smelling	.35	.62	0-2
Listening	.22	.42	0-1
Bouncing	.08	.26	0-1
Shaking	.23	.42	0-1
Drawing	.02	.13	0-1
Anticipatory Actions			
Towards Pictures	.13	.36	0-2
Towards Objects	.04	.20	0-1
Misplaced Manipulation	.18	.44	0-2
No Referent Present	.10	.33	0-2

[a] The mean and standard deviation for blocking light behavior that occurred out of the context of picture-referent questioning were .07 and .25, respectively.

Table 10

Means and Standard Deviations of Total Haptic Picture Scores and Subscores

for Representational Medium x Mode x Age x Sex Conditions

	Rep. Medium		Mode		Age		Sex	
	Prints (n=60)	Slides (n=60)	Color (n=60)	Black & White (n=60)	3 Years (n=60)	5 Years (n=60)	Males (n=54)	Females (n=66)
Total Haptic Score								
Mean	2.77	3.07	3.17	2.67	3.58	2.25	3.81	2.18
SD	2.81	3.07	3.14	2.72	3.10	2.62	2.99	2.69
Functional Subscore								
Mean	.55	1.00	.80	.75	1.02	.53	1.02	.58
SD	1.02	1.40	1.31	1.17	1.32	1.11	1.31	1.15
Existence Subscore								
Mean	.18	.18	.22	.15	.22	.15	.28	.11
SD	.54	.50	.56	.48	.56	.48	.68	.31
Phys. Prop. Subscore								
Mean	2.03	1.88	2.15	1.77	2.35	1.57	2.52	1.50
SD	1.82	1.72	1.85	1.67	1.93	1.50	1.73	1.67

picture scores. Similarly, sex differences in haptic picture behavior were a function of age and representational medium. Thus, for 3-year-olds, the performance of males and females diverged most under the print condition whereas for 5-year-olds, it was the slide condition which elicited the greatest differential between the sexes. Tukey HSD tests comparing the haptic picture means of the various subgroups revealed that 3-year-old males in the print condition differed significantly from 5-year-old females in both the slide and print conditions at the .01 and .05 levels, respectively. Five-year-old males and females in the slide condition also differed significantly from each other at the .05 level. There were no other significant subgroup comparisons.

To examine the effect of question type on children's manipulation of pictures, children's total haptic picture scores were subdivided into functional, existence, and physical property subscores. The means and standard deviations for the three haptic picture subscores are presented in Table 10. The results of four-way analyses of variance performed on these subscores follow.

In terms of the functional haptic subscores, significant main effects were found for representational medium, F (1, 104) = 4.78, $p < .05$, age, F (1, 104) = 5.49, $p < .05$ and sex, F (1, 104) = 5.07, $p < .05$. There was also a significant sex x age interaction, F (1, 104) = 4.01, $p < .05$ and a significant representational medium x sex x age interaction, F (1, 104) = 6.17, $p < .05$. Thus, in terms of responding to functional questions, (1) children were significantly more apt to manipulate slides than prints, (2) 3-year-olds were more likely to engage

Table 11

Mean Total Haptic Picture Scores by Representational Medium, Age, and Sex

Age/Sex	Representational Medium		
	Prints	Slides	Total
3 Years			
Males	5.15	3.54	4.35
Females	2.53	3.47	3.00
5 Years			
Males	2.20	4.62	3.32
Females	1.53	1.12	1.31
Total	2.77	3.07	

Note. N = 120.

in haptic behavior than 5-year-olds and (3) males were more likely to manipulate pictures than females. The significant age x sex interaction associated with functional haptic picture subscores is shown in Table 12. Manipulation of pictures in response to functional questions declined with age for females, but not for males, with the result that sex differences in manipulation for this question type appeared only at the 5-year-old level. Tukey HSD tests comparing the functional haptic picture scores of the various subgroups revealed that 5-year-old females differed significantly from 3-year-old males and females at the .01 level, and from 5-year-old males at the .05 level. There were no other significant subgroup comparisons. The significant representational medium x age x sex interaction is illustrated in Table 13. While on the whole, 3-year-olds engaged in more functional haptic behavior than 5-year-olds, the two groups differed in terms of the manner in which they were influenced by representational medium and sex. Whereas among 5-year-olds, males obtained higher functional haptic picture scores across representational media, and slides elicited more functional manipulation regardless of sex, the findings with respect to the 3-year-olds were much more diverse. Thus, under the slide condition, it was the 3-year-old females who achieved the highest functional haptic picture scores, but when prints were considered, the effect was reversed, with 3-year-old males obtaining the highest scores. Tukey HSD tests comparing the functional haptic picture means obtained by the various subgroups revealed that 5-year-old females in the print condition differed significantly from 3-year-old females and 5-year-old males in the

Table 12

Mean Functional Haptic Picture

Subscores by Age and Sex

	Age		
Sex	3 Years	5 Years	Total
Males	1.04	1.00	1.02
Females	1.00	.13	.58
Total	1.02	.53	

Note. N = 120.

Table 13

Mean Functional Haptic Picture Subscores

by Representational Medium, Age, and Sex

	Representational Medium		
Age/Sex	Prints	Slides	Total
3 Years			
Males	1.15	.92	1.04
Females	.59	1.41	1.00
5 Years			
Males	.47	1.62	1.00
Females	.07	.18	.12
Total	.55	1.00	

Note. N = 120.

slide condition at the .05 level. None of the other subgroup comparisons was significant.

Manipulation occurring in response to physical property questions followed a pattern similar to that found with respect to functional questions. There were significant main effects for age and sex, F (1,104) = 7.28, $p < .01$ and F (1, 104) = 12.64, $p < .001$, respectively. There was also a significant representational medium x sex x age interaction, F (1, 104) = 5.17, $p < .05$. Thus, in terms of physical property questions, 3-year-olds were significantly more likely to engage in haptic behavior than 5-year-olds, and males were more likely to manipulate pictures than females. The significant representational medium x sex x age interaction is illustrated in Table 14. While overall 3-year-olds engaged in more pictorial manipulation in response to physical property questions than 5-year-olds, within a given age group, the tendency to explore pictures varied according to both sex and representational medium. Thus, among 3-year-olds, males in the print condition exhibited the most physical property manipulation whereas among the 5-year-olds, it was the males in the slide condition who achieved the highest physical property haptic picture scores. Similarly, sex differences in haptic picture behavior in response to physical property questions were a function of age and representational medium. Thus, for 3-year-olds, the performance of males and females diverged most under the print condition, whereas for 5-year-olds, it was the slide condition which elicited the greatest differential between the sexes. Tukey HSD tests comparing the physical property haptic picture means of the

various subgroups revealed that 3-year-old males in the print condition differed significantly from 5-year-old males and females in the print condition at the .05 level, and from 5-year-old females in the slide condition at the .01 level. The comparison between 5-year-old males and 5-year-old females in the slide condition just missed significance at the .05 level. There were no other significant subgroup comparisons.

In contrast to the significant findings reported for both functional and physical property subscores, much less haptic behavior was elicited by existence questions, and none of the effects or interactions proved significant. The only effect to approach significance was that of sex, $F(1, 104) = 3.49$, $p < .10$. Here, as with the other question types, boys were more likely to manipulate the pictures than girls.

While the preceding findings were concerned with effects within individual question types on the tendency to haptically explore pictures, the next group of analyses deals with comparison across question types. The mean haptic picture scores associated with the three question types appear in Table 5. Physical property questions elicited the most pictorial manipulation, followed by functional and existence questions, respectively. Correlated t-tests performed on these mean scores revealed that the various question types all differed from each other at the .001 level. These findings held true for correlated t-tests performed separately for the two age groups.

To summarize, examination of haptic behaviors elicited in response to questions about iconic realism revealed that subjects

Table 14

Mean Physical Property Haptic Picture Subscores by Representational Medium, Age and Sex

	Representational Medium		
Age/Sex	Prints	Slides	Total
3 Years			
Males	3.62	2.31	2.96
Females	1.76	2.00	1.88
5 Years			
Males	1.67	2.62	2.11
Females	1.33	.88	1.09
Total	2.03	1.88	

Note. N = 120.

exhibited a wide variety of responses. Analysis revealed that, in general, the tendency to haptically explore pictures varied as a function of age and sex, with 3-year-olds significantly more likely to manipulate pictures than 5-year-olds, and males more apt to touch pictures than females. The significant representational medium x age x sex interaction elaborated these findings by indicating that with a given age group, pictorial manipulation varied according to both sex and representational medium. Thus, among 3-year-olds, it was found that males in the print condition exhibited the most manipulation whereas among 5-year-olds, it was the males in the slide condition who achieved the highest haptic scores. Sex differences in haptic picture behavior were similarly a function of age and representational medium.

Within question type, analysis revealed that functional haptic picture subscores varied as a function of representational medium, age, and sex. The significant sex x age interaction associated with these subscores indicated that manipulation of pictures in response to functional questions declined with age for females, but not males. The significant representational medium x age x sex interaction demonstrated further diversity among these findings. At the 5-year-old level, males consistently obtained higher functional haptic picture scores regardless of representational medium, and slides elicited more functional manipulation regardless of sex. In contrast, at the 3-year-old level, under the slide condition, females achieved the highest functional haptic picture scores, whereas under the print condition, it was the males who obtained the highest scores.

Manipulation occurring in response to physical property questions varied as a function of age and sex, and the significant representational medium x age x sex interaction reflected a pattern of findings similar to that found with total haptic picture scores. Existence haptic subscores were unique in that analysis uncovered no significant effects or interactions. Comparison across question type revealed significant differences in the amount of pictorial manipulation elicited by the various question types, with physical property questions eliciting the most motoric exploration and existence questions the least.

Since both haptic picture and iconic realism scores represent responses to the same sequence of questions, correspondance between their findings will now be considered. While haptic behavior showed greater diversity, both total iconic realism and haptic picture scores were similarly affected by age. Scores on both measures were significantly higher for 3-year-olds than for 5-year-olds. This age effect was upheld for all three iconic subscores as well as functional and physical property haptic subscores. Of the three question types, physical property questions elicited the most iconic realism and haptic behavior. Functional questions elicited the least iconic realism and were associated with little haptic exploration. The findings on existence questions differed from other question types on both verbal and haptic measures. In terms of iconic realism, existence questions were the only ones significantly affected by representational medium. In respect to haptic behavior, existence questions were again unique in eliciting almost no haptic

exploration and evidencing no effects or interactions. The relationship between iconic realism and haptic picture behavior is examined in further detail in the subsequent sections dealing with confirmatory/disconfirmatory behavior and intercorrelations between dependent measures.

Confirmatory/Disconfirmatory Behavior.

Pilot work revealed that, in the course of questioning, children sometimes modified or reaffirmed their responses while manipulating pictures. These responses represent a subset of children's iconic and non-iconic responses and could be categorized as "confirmation" or "disconfirmation," depending on their relationship to the manipulation the child chose to perform. Iconic or non-iconic responses were considered eligible for classification only if the following criteria were met:

1. the child made a verbal prediction regarding the nature of the photographic print or the screen upon which the slide was projected (e.g., "I think it will be cold")

2. manipulated the print or screen (e.g., touched it)

3. and made a comment (e.g., "It's not cold")

Instances in which the child manipulated the picture prior to making a prediction or where the child made no comment following manipulation were not included. The four categories of confirmation and disconfirmation were as follows:

1. Positive Confirmation. (e.g., the child predicted that the picture of an ice cream cone would feel cold, touched the picture, and said, "It's cold")

2. Negative Confirmation. (e.g., the child predicted the picture of an ice cream cone would not feel cold, and confirmed

this verbally after touching the picture)

3.Positive Disconfirmation. (e.g., the child predicted the picture of an ice cream cone would not feel cold, but decided it did feel cold upon touching the picture)

4.Negative Disconfirmation. (e.g., the child predicted the picture of an ice cream cone would feel cold, but changed his mind upon touching the picture, commenting, "It's not cold")

As examination of the aforementioned categories reveals, while in positive and negative confirmation the nature of the child's original response remained essentially unchanged, in the case of positive and negative disconfirmation, non-iconic reponses became iconic, and iconic responses became non-iconic, respectively. Children's iconic totals discussed earlier reflect these changes since the child's last response was the one that was scored. In scoring confirmatory/disconfirmatory behavior, the child was credited with one point each time a classifiable behavior occurred.

In analyzing children's confirmatory/ disconfirmatory behavior, it should be recalled that children's haptic picture scores varied significantly according to age and sex. In order to control for the effect of differences in haptic picture behavior on confirmations and disconfirmations, for each category of behavior, the child was assigned the proportion that that category (e.g., positive confirmation) represented of that child's total haptic picture score. Subjects who did not engage in any haptic picture behavior were therefore excluded from the analysis. The means and standard deviations associated with the

categories of confirmatory/disconfirmatory behavior appear in Table 15. A four-way analysis of variance, Representational Medium (Prints, Slides) x Mode (Color, Black and White) x Sex (Male, Female) x Age (3 Years, 5 Years), was performed on these proportions. In the presentation which follows, percentages are based on mean proportions.

For positive confirmations, which constituted only a small proportion (overall mean = .06) of child's haptic picture responses, there were no significant effects or interactions. The only finding which approached significance was a representational medium x sex x age interaction, F (1, 76) = 3.18 p <.10. In contrast, negative confirmations constituted the most frequent form of confirmatory/disconfirmatory behavior, and accounted for 25% of children's haptic picture responses. Negative confirmations varied significantly with age, F (1, 76) = 7.21, p <.01, with 5-year-olds reaffirming non-iconic responses proportionately more often than their 3-year-old counterparts. There were no other significant effects or interactions associated with negative confirmations.

As in the case of positive confirmations, positive disconfirmations occurred infrequently, representing on the whole only 4% of children's haptic picture behavior. There were no significant effects or interactions associated with positive disconfirmations.

Negative disconfirmations represented the second most frequent form of confirmatory/disconfirmatory behavior, accounting for 12% of children's haptic picture behavior. The proportion of negative disconfirmations varied significantly

Table 15

Means and Standard Deviations of Proportions of Confirmatory/Disconfirmatory Responses for Representational Medium x Mode x Age x Sex Conditions

Category	Rep. Medium		Mode		Age		Sex	
	Prints (n=47)	Slides (n=45)	Color (n=48)	Black & White (n=44)	3 Years (n=47)	5 Years (n=45)	Males (n=48)	Females (n=44)
Positive Confirmation								
Mean	.06	.05	.06	.05	.08	.04	.05	.06
SD	.17	.11	.17	.11	.13	.16	.12	.18
Negative Confirmation								
Mean	.21	.29	.25	.25	.17	.34	.23	.28
SD	.28	.32	.30	.31	.20	.36	.28	.32
Positive Disconfirmation								
Mean	.05	.02	.05	.03	.02	.05	.05	.02
SD	.21	.15	.20	.16	.15	.21	.21	.15
Negative Disconfirmation								
Mean	.10	.13	.08	.15	.16	.07	.14	.09
SD	.17	.21	.14	.22	.17	.19	.22	.15

Note. Each category of confirmatory/disconfirmatory behavior was assigned the proportion that it represented of the total haptic picture score.

with age, F (1, 76) = 4.46, $p < .05$. Thus, 3-year-olds were proportionately more likely than 5-year-olds to change their responses from iconic to non-iconic as a consequence of pictorial manipulation. The effect of pictorial mode approached significance, F (1, 76) = 2.77, $p = .10$, with black and white pictures subject to more negative disconfirmation than color pictures. There were no other significant effects or interactions associated with negative disconfirmations.

To summarize, analysis of iconic and non-iconic responses that occurred in conjunction with manipulation revealed that such behavior often served the purpose of allowing the child to either modify or reaffirm his original response. Few positive confirmations occurred, suggesting that children rarely re-affirmed iconic responses. Positive disconfirmations were also infrequent in that children rarely changed non-iconic responses to iconic on the basis of manipulating pictures. In contrast, negative confirmations and disconfirmations occurred frequently. Negative confirmations, the most common form of confirmatory/disconfirmatory response, varied significantly with age, suggesting that 5-year-olds were proportionately more likely to use physical manipulation for the purpose of re-affirming non-iconic responses than 3-year-olds. Negative disconfirmations were also associated with a significant main effect for age. Here the age effect was reversed, with 3-year-olds proportionately more likely than 5-year-olds to change responses from iconic to non-iconic in the face of what can be considered contradictory manipulative input. Earlier findings with respect to children's iconic scores should be interpreted in

light of these results, in that 3-year-olds' iconic realism scores would have been even higher were it not for the corrective role played by physical manipulation.

Justifications. Three types of justifications were provided by children during the course of picture-referent questioning: (1) reasons for attributing the properties of real objects to photographs ("iconic justifications") (2) reasons for not attributing the properties of real objects to photographs ("non-iconic justifications") and (3) reasons for attributing properties or functions to referents ("referent justifications"). The following classification scheme was based on the system developed by Pearlman and Beilin (1979), and revised in accordance with sample data from the present investigation. The subcategories associated with the three justification types follow:

1. Iconic Justifications

(a) Content-Related. The child responded as if photographs could be treated or characterized in the same way as their real world referents. For example, a picture of an ice cream cone was said to feel cold because "it was in the freezer" or because "ice cream's always cold," or simply because "it is ice cream." The focus was on the represented subject matter as opposed to the medium of representation.

(b) Reciprocal. The child behaved as if an action performed on either the picture or referent reciprocally affected its counterpart. For example, when asked what would happen to the picture of a glass of orange juice once someone drank the

contents of its referent, one subject, age 3-9, replied, "The juice (picture) wouldn't be there ... cause I drank this juice (referent) up." Similarly, another subject, age 3-11, indicated that the referent ball would break "cause this one (picture) be ripped in half." This category applied predominantly to existence questions.

(c) Ambiguous/Idiosyncratic. Either the meaning behind the child's explanation remained unclear despite probing, or the child made reference to some irrelevant, idiosyncratic reason for attributing the properties of real objects to pictures. For example, when asked to explain why a picture of an ice cream cone would feel cold, one subject, age 3-6, could only respond, "Because it has to." Similarly, when asked why a picture of a banana would smell like a banana, another subject, age 3-9, answered, "Because monkeys eat bananas."

(d) No Justification. The child explicitly indicated that he could not justify his iconic response or simply made no effort to do so, even upon probing.

(e) No Justification, Unprobed. This category was comprised of cases in which a child engaged in confirmatory/disconfirmatory behavior, responded iconically, yet failed to spontaneously provide a justification for his response. The experimenter did not probe for explanations in these instances.

2. Non-Iconic Justifications

(a) Representational. The child made reference to the fact that photographs are only representations of objects and therefore not equivalent to real world referents. Thus, one

cannot eat a picture of a banana "because it's not real, and you'll get sick if you eat this picture." Similarly, nothing would happen to the referent watch once its picture was destroyed "because that watch is pretend ...it's on the screen."

(b) Perceptual. Here the child referred to perceptual differences between object and photograph, such as dimensionality, color, size, or material. For instance, nothing would happen to a rattle if its picture were destroyed because "that one's orange and this one's yellow." Similarly, the referent ball would not be affected once its picture was destroyed "because this is big and that's little."

(c) Partial. Here the child attempted to give some indication of the intangibility of objects represented in photographs or of the non-reciprocality of an action performed on one form to another, but was unable to fully specify the nature of the photographic surface, or the relationship between the two forms. Thus, one cannot drink a picture of a glass of juice because "it's 'stuck' in here (picture). If I drink it, if I'm drinking, I drink this (referent)." Similarly, nothing would happen to a picture of a glass of juice once its referent was consumed "because if you drink the orange juice (referent), the other one (picture) doesn't go down."

(d) Ambiguous/Idiosyncratic. Either the meaning behind the child's explanation remained unclear despite probing, or the child made reference to some irrelevant, idiosyncratic reason for not attributing the properties of real objects to pictures. Thus, nothing would happen to the referent ball if its picture were

destroyed because "it has stars on it." Similarly, another subject, when asked if he could drink a picture of a glass of juice, replied, "No, because that (referent) is to drink," yet could not elaborate further.

(e) No Justification. The child explicitly indicated that he could not justify his non-iconic response, or simply made no effort to do so, even upon probing by the experimenter.

(f) No Justification, Unprobed. This category was comprised of cases in which a child engaged in confirmatory/disconfirmatory behavior, responded non-iconically, but failed to spontaneously provide a justification for his response. The experimenter did not probe for explanations in these instances.

3. Referent Justifications

(a) Real. Here referents are characterized as real as opposed to photographs, which are viewed purely as representations of objects. Thus, according to one 5-year-old, he could hear the referent watch "because if you took that and wind it up, it would tick because it's a real watch." Similarly, one could eat ice cream from the candy-store "cause it's the real one, and you could eat real ice cream."

(b) Content-Related. The child described some property or action normally associated with the object in question. Thus, the flame on the referent candle would feel hot "because you light it with matches," or because "it would burn you all up," or simply "because it's fire."

(c) Ambiguous/Idiosyncratic. Either the meaning behind the child's explanation remained unclear despite probing, or the child made reference to some irrelevant, idiosyncratic reason for

his attribution. For instance, when asked why he could eat an ice cream cone from a candy-store, one 5-year-old responded, "because you're big and I'm little." Another 5-year-old, when asked why ice cream from the candy-store would feel cold, replied, "Cause it's made by a cow."

(d) Partial. Here the child attempted to give some indication of the tangibility of real objects as opposed to the intangibility of items represented in photographs, but was unable to specify the distinction between the two forms. Thus, when asked why one could write with the referent crayon, one child, age 5-1, explained, "Because that one's (picture) inside and that one (referent) isn't ... that one's just in there." Similarly, one could drink the referent juice because "it's out here."

(e) No Justification. The child explicitly indicated that he could not justify his response, or simply made no effort to do so, even upon probing by the experimenter.

In scoring, a child was credited with one point for each classifiable explanation. As indicated earlier, children sometimes changed their responses during questioning, and when this occurred, the child's final justification was the one that was scored. As a reliability check, an independent rater was briefed regarding the system of classification and re-categorized 25% of the protocols, chosen randomly. The percentage of agreement between the classifications made by the experimenter and the rater was 95% (in 899 categorizations).

In analyzing children's iconic justifications, for each category, the child was assigned the proportion that that

category (e.g., content-related) represented of the total number of iconic responses given by the child. Subjects with no iconic responses were excluded from the analysis. The means and standard deviations for the categories of iconic justifications are presented in Table 16. Four-way analyses of variance, Representational Medium (Prints, Slides) x Mode (Color, Black and White) x Sex (Male, Female) x Age (3 Years, 5 Years), were performed on these proportions. In the presentation which follows, the percentages are based on mean proportions.

Content-related justifications (overall mean = .41) represented the most frequently used iconic justification. While there were no significant main effects, both the mode x sex interaction and the mode x age interaction were significant, F (1, 56) = 4.72, $p < .05$ and F (1, 56) = 4.64, $p < .05$, respectively. There were no other significant interactions. The significant mode x sex interaction associated with content-related justifications is shown in Table 17. While sex differences remained constant regardless of condition, the group providing the most content-related iconic justifications varied as a function of pictorial mode. Thus, females supplied proportionately more content-related justifications than males for color pictures, with the reverse for the black and white condition, where males supplied more of these explanations than females. Tukey HSD tests comparing the mean proportion of content-related iconic justifications revealed no significant differences between the subgroups treated by this interaction.

The significant mode x age interaction associated with content-related iconic justifications is shown in Table 18.

Table 16

Means and Standard Deviations of Proportions of Iconic Justifications

For Representational Medium x Mode x Age x Sex Conditions

	Rep. Medium		Mode		Age		Sex	
Justifications	Prints (n=34)	Slides (n=38)	Color (n=36)	Black & White (n=36)	3 Years (n=51)	5 Years (n=21)	Males (n=31)	Females (n=41)
Content-Related								
Mean	.38	.44	.44	.39	.42	.41	.42	.41
SD	.38	.37	.39	.36	.36	.42	.40	.36
Reciprocal								
Mean	.01	.06	.05	.01	.04	.02	.03	.04
SD	.04	.14	.14	.05	.12	.07	.09	.12
Ambiguous/Idiosyn.								
Mean	.09	.10	.05	.14	.12	.04	.09	.10
SD	.20	.16	.12	.22	.19	.13	.19	.18
No Justification								
Mean	.36	.25	.29	.31	.29	.34	.23	.36
SD	.39	.36	.37	.39	.37	.40	.34	.39
No Justification, unprobed								
Mean	.14	.06	.11	.09	.07	.17	.16	.05
SD	.26	.13	.21	.20	.14	.31	.28	.11

Note. Each category was assigned the proportion that it represented of the total iconic realism score. *Proportions* do not total 1.00 due to missing cases.

Table 17

Mean Proportion of Content-Related Iconic Justifications by Mode and Sex

Sex	Mode		Total
	Color	Black & White	
Males	.33	.47	.42
Females	.49	.29	.41
Total	.44	.39	

Note. N = 72.

Three-year-olds provided the same proportion of content-related justifications for their iconic responses regardless of pictorial mode. In contrast, 5-year-olds were proportionately more likely to provide content-related justifications for color as opposed to black and white stimuli. Within the color condition, the proportion of content-related justifications increased with age, whereas under the black and white condition, a decrease with age was shown. Tukey HSD tests comparing the mean proportion of content-related iconic justifications revealed no significant differences between the subgroups treated by this interaction.

In contrast to content-related justifications, reciprocal justifications, the notion that destroying a photograph or object adversely affects its counterpart, were the most infrequently used iconic justification. On the whole, reciprocal justifications accounted for only 3% of iconic justifications. There were no significant main effects or interactions associated with reciprocal justifications. The only effect to approach significance was representational medium, $F(1, 56) = 3.46$, $p < .10$ with slides eliciting proportionately more reciprocal justifications than photographic prints.

Ambiguous/idiosyncratic justifications accounted for 9% of all iconic justifications. The effect of mode proved significant, $F(1, 56) = 4.06$, $p < .05$. Thus, subjects in the black and white condition provided a significantly higher proportion of ambiguous or idiosyncratic justifications for iconic responses than their counterparts viewing color pictures. There were no other significant effects or interactions associated with the ambiguous/idiosyncratic category.

Table 18

Mean Proportion of Content-Related Iconic Justifications by Mode and Age

Age	Mode		Total
	Color	Black & White	
3 Years	.40	.43	.42
5 Years	.54	.28	.41
Total	.44	.39	

Note. N = 72.

The "no justification" category represented the second most frequently given iconic justification, accounting for 30% of iconic justifications. There were no significant main effects. Sex approached significance, F (1, 56) = 3.08, $p < .10$, with females the more likely of the sexes to offer no justification for their iconic responses. There were three significant two-way interactions associated with the "no justification" category. The significant mode x sex interaction, F (1, 56) = 4.46, $p < .05$, is shown in Table 19. As indicated, while both sexes provided the same proportion of "no justifications" when viewing color pictures, under the black and white condition, females' explanations fell into the "no justification" category proportionately more often than males. Correspondingly, for males, the proportion of no justifications was higher for color as opposed to black and white pictures, whereas for females, the proportion of these explanations was higher for black and white pictures. Tukey HSD tests revealed no significant differences in the mean proportion of "no justifications" given by the subgroups treated by this interaction.

The significant mode x age interaction associated with the "no justification" category, F (1, 56) = 7.89, $p < .01$, is illustrated in Table 20. Five-year-olds gave a higher proportion of "no justifications" for black and white as opposed to color pictures, whereas for 3-year-olds, a higher proportion of "no justifications" was elicited by color pictures as opposed to black and white ones. Correspondingly, within the color condition, the proportion of no justifications decreased with age whereas within the black and white condition, the proportion of

Table 19

Mean Proportion of No Justifications for Iconic Responses by Mode and Sex

	Mode		
Sex	Color	Black & White	Total
Males	.29	.19	.23
Females	.29	.46	.36
Total	.29	.31	

Note. N = 72.

such explanations increased with age. Tukey HSD tests comparing the mean proportion of "no justifications" given by the various subgroups revealed no significant differences.

The significant sex x age interaction associated with the "no justification" category, F (1, 56) = 4.88, $p < .05$, is shown in Table 21. Females at both the 3-year-old and 5-year-old level provided a higher proportion of "no justifications" than their male counterparts, the difference between the sexes being especially marked at the 5-year-old level. Correspondingly, for males as a whole, the proportion of "no justifications" decreased with age, whereas for females the proportion of such explanations increased with age. Tukey HSD tests comparing the mean proportion of "no justifications" revealed no significant differences between the subgroups.

Finally, the "no justification, unprobed" category represented 10% of all iconic justifications. Only the main effect of sex proved significant, F (1, 56) = 5.83, $p < .05$, with males proportionately more apt not to justify an iconic response following confirmatory/disconfirmatory behavior. Representational medium approached significance, F (1, 56) = 3.10, $p < .10$, with iconic responses to prints remaining unprobed somewhat more often than iconic responses elicited by slides. Lastly, the representational medium x sex interaction also approached significance, F (1, 56) = 3.11, $p < .10$. There were no other significant effects or interactions associated with this justification category.

As in the case of iconic justifications, each non-iconic category was assigned the proportion that that category (e.g.,

Table 20

Mean Proportion of No Justifications for

Iconic Responses by Mode and Age

	Mode		
Age	Color	Black & White	Total
3 Years	.33	.25	.29
5 Years	.20	.46	.34
Total	.29	.31	

Note. N = 72.

Table 21

Mean Proportion of No Justifications for

Iconic Responses by Sex and Age

	Sex		
Age	Males	Females	Total
3 Years	.25	.31	.29
5 Years	.19	.53	.34
Total	.23	.36	

Note. N = 72.

partial) represented of the total number of non-iconic responses given by the child. The means and standard deviations for the categories of non-iconic justifications appear in Table 22. Four-way analyses of variance, Representational Medium (Prints, Slides) x Mode (Color, Black and White) x Sex (Males, Females) x Age (3 Years, 5 Years), were performed on these proportions. In the presentation which follows, the percentages are based on mean proportions.

Representational justifications were the most widely used non-iconic justification, accounting for 67% of all such explanations. Age was the only significant factor, F (1,104) = 8.67, $p < .01$. Five-year-olds provided representational justifications for their non-iconic responses significantly more often than 3-year-olds. The effect of mode also approached significance, F (1,104) = 3.52, $p < .10$, indicating that color pictures were somewhat more likely to elicit representational justifications than their black and white counterparts. There were no significant interactions, although the sex x age interaction approached significance, F (1,104) = 2.94, $p < .10$.

Perceptual justifications were the most infrequently used non-iconic justification, accounting, on the whole, for only 2% of such justifications. Although there were no significant effects or interactions, the representational medium x age interaction, and the representational medium x mode x age interaction both approached significance, F (1, 104) = 3.09, $p < .10$, and F (1, 104) = 3.69, $p < .10$, respectively.

Partial justifications accounted for 6% of non-iconic justifications. While there were no significant main effects

Table 22

Means and Standard Deviations of Proportions of Non-Iconic Justifications for Representational Medium x Mode x Age x Sex Conditions

Justifications	Rep. Medium		Mode		Age		Sex	
	Prints (n=60)	Slides (n=60)	Color (n=60)	Black & White (n=60)	3 Years (n=60)	5 Years (n=60)	Males (n=54)	Females (n=66)
Representational								
Mean	.68	.66	.72	.62	.59	.75	.65	.69
SD	.29	.32	.27	.33	.33	.25	.29	.32
Partial								
Mean	.04	.07	.06	.06	.06	.05	.07	.05
SD	.07	.12	.11	.09	.11	.09	.09	.11
Perceptual								
Mean	.03	.01	.01	.03	.02	.01	.02	.01
SD	.09	.03	.02	.09	.09	.04	.09	.03
Ambiguous/Idiosyn.								
Mean	.10	.11	.09	.12	.16	.05	.11	.10
SD	.14	.16	.13	.16	.18	.07	.16	.15
No Justification								
Mean	.11	.10	.08	.13	.11	.10	.09	.11
SD	.21	.20	.17	.23	.19	.21	.18	.22
No Justification, unprobed								
Mean	.04	.05	.04	.05	.06	.04	.06	.03
SD	.06	.07	.06	.07	.07	.06	.08	.05

Note. Each category was assigned the proportion that it represented of all non-iconic justifications.

Proportions may not total 1.00 in all instances due to missing cases.

associated with partial justifications, the mode x sex x age interaction proved significant, F (1,104) = 5.28, $p < .05$. This interaction is shown in Table 23. While both age groups provided approximately the same proportion of partial justifications, within a given age group, the proportion of such justifications varied as a function of mode and sex. For 3-year-olds, while females viewing color pictures provided a slightly higher proportion of partial justifications than males, these findings were reversed with respect to black and white pictures, where males provided a slightly higher proportion of such justifications. Similarly,at the 5-year-old level, while males viewing color pictures provided a somewhat higher proportion of partial justifications than females, with respect to the black and white condition, the reverse proved true. Sex differences remained fairly constant across pictorial mode within a given age group. Tukey HSD tests comparing the mean proportion of partial justifications revealed no significant differences between the subgroups treated by this interaction.

Ambiguous or idiosyncratic justifications accounted for 11% of all non-iconic justifications. Age proved significant, F (1, 104) = 18.46, $p < .001$. Thus, 3-year-olds were proportionately more likely than 5-year-olds to provide ambiguous or idiosyncratic justifications for their non-iconic responses. While there were no other significant effects or interactions associated with the ambiguous/idiosyncratic category, the mode x age interaction approached significance, F (1,104) = 3.30 $p < .10$.

The "no justification" category accounted for 10% of non-

Table 23

Mean Proportion of Partial Justifications for Non-Iconic Responses by Mode, Age and Sex

	Mode		
Age/Sex	Color	Black & White	Total
3 Years			
Males	.05	.08	.07
Females	.08	.05	.05
5 Years			
Males	.08	.02	.06
Females	.02	.08	.05
Total	.06	.06	

Note. N = 120.

iconic justifications. The only relevant finding associated with this justification category was a significant representational medium x mode x sex interaction, F (1,104) = 5.76, $p < .05$. This interaction is shown in Table 24. While, as a whole, prints and slides elicited approximately the same proportion of "no justifications," within a given representational medium, the proportion of "no justifications" varied as function of mode and sex. Thus, within the photographic print condition, the highest proportion of "no justifications" was provided by females viewing color pictures whereas within the slide condition, the highest proportion of "no justifications" was provided by females viewing black and white pictures. Correspondingly, sex differences in the proportion of "no justifications" were a function of representational medium and mode. Thus, for photographic prints, the performance of males and females diverged most under the color condition whereas for slides, it was the black and white condition that elicited the greatest differential between the sexes. Tukey HSD tests performed on the mean proportion of "no justifications" revealed no significant differences between the subgroups treated by this interaction.

Lastly, the "no justification, unprobed" category represented 5% of all non-iconic justifications. The main effect of sex proved significant, F (1,104) = 6.78, $p < .05$, indicating that males were more apt than females not to justify a non-iconic response following confirmatory/disconfirmatory behavior. There were no other significant effects or interactions associated with this justification category.

As in the case of iconic and non-iconic justifications, each

Table 24

Mean Proportion of No Justifications for Non-Iconic Responses by Representational Medium, Mode, and Sex

	Representational Medium		
Mode/Sex	Prints	Slides	Total
Color			
Males	.03	.09	.06
Females	.17	.03	.09
Black & White			
Males	.14	.10	.12
Females	.08	.20	.14
Total	.11	.10	

Note. N = 120.

referent category was assigned the proportion that that category (e.g., real) represented of the total number of referent attributions given by the child. The means and standard deviations for the categories of referent justifications appears in Table 25. Four-way analyses of variance, Representational Medium (Prints, Slides) x Mode (Color, Black and White) x Sex (Males, Females) x Age (3 Years, 5 Years), were performed on these proportions. In the presentation which follows, the percentages are based on mean proportions.

Content-related justifications, whereby a child described some property or action normally associated with the object in question, were the most frequently given referent justification. Thus, when asked why one could eat the referent banana, typical responses included "because it's a banana and it's food" or "because it's healthy and it's good." Content-related justifications accounted for 40% of referent justifications. Significant main effects were found for both age, F (1,104) = 5.01, $p < .05$ and sex, F (1,104) = 4.87, $p < .05$. Thus, 3-year-olds provided content-related justifications for their referent attributions proportionately more often than 5-year-olds, and males were proportionately more apt to offer content-related justifications than females. There were no other significant main effects or interactions. The only other relevant finding associated with content-related referent justifications was a sex x age interaction which approached significance, F (1,104) = 3.86, $p < .10$.

Real justifications, whereby a contrast is drawn between real and representational, were the second most frequently

Table 25

Means and Standard Deviations of Proportions of Referent Justifications for Representational Medium x Mode x Age x Sex Conditions

	Rep. Medium		Mode		Age		Sex	
Justifications	Prints (n=60)	Slides (n=60)	Color (n=60)	Black & White (n=60)	3 Years (n=60)	5 Years (n=60)	Males (n=54)	Females (n=60)
Content-Related								
Mean	.38	.42	.42	.38	.45	.36	.45	.36
SD	.26	.23	.23	.27	.24	.24	.27	.22
Real								
Mean	.40	.35	.40	.36	.25	.51	.31	.43
SD	.33	.30	.29	.34	.28	.30	.31	.31
Partial								
Mean	.00	.02	.01	.01	.00	.01	.00	.02
SD	.02	.08	.03	.08	.03	.08	.01	.08
Ambiguous/Idiosyn.								
Mean	.09	.08	.07	.10	.14	.03	.09	.08
SD	.15	.15	.11	.18	.19	.06	.15	.15
No Justification								
Mean	.12	.12	.09	.14	.14	.09	.14	.10
SD	.20	.20	.17	.21	.20	.20	.23	.16

Note. Each category was assigned the proportion that it represented of the total referent score. Proportions may not total 1.00 in all instances due to missing cases.

occurring (38%) referent justification. For example, when asked why nothing would happen to the referent ball once its picture was destroyed, one 5-year-old replied, "Because that's a real ball (referent) and that's connected to the screen (picture)." Significant main effects were found for age, F (1,104) = 26.14, $p < .001$ and sex, F (1, 104) = 5.93, $p < .05$. There was also a significant representational medium x mode x sex interaction, F (1, 104) = 6.79, $p < .05$. There were no other significant effects or interactions, although the mode x sex interaction approached significance, F (1, 104) = 2.96 $p < .10$. The main effect for age indicated that 5-year-olds were proportionately more apt than 3-year-olds to characterize an object as "real" to justify referent attributions. Similarly, the sex effect indicated that females were proportionately more likely to provide "real" justifications for referent attributions than males. The significant representational medium x mode x sex interaction is shown in Table 26. With respect to black and white pictures, females consistently provided a higher proportion of "real" justifications than males regardless of whether slides or prints were viewed, with these sex differences remaining constant across representational media. In contrast, with respect to color pictures, while females provided a higher proportion of "real" justifications than males for slides, these findings were reversed under the print condition where males provided a higher proportion of such justifications than females. Thus, females provided a higher proportion of "real" justifications for color slides than for color prints while males provided a higher proportion of "real" justifications for color prints than for

color slides. Tukey HSD tests comparing the mean proportion of "real" justifications provided by the various subgroups revealed that males in the color/print condition differed significantly from males in the color/slide condition at the .05 level. None of the other subgroup comparisons proved significant.

Partial justifications, whereby a child attempted to give some indication of the tangibility of referents, were the most infrequently used referent justification (population mean = .01). There were no significant effects or interactions associated with partial justifications.

Ambiguous/idiosyncratic justifications accounted, on the whole, for 9% of referent justifications. Age had a significant effect, F (1, 104) = 19.18, $p < .001$, with 3-year-olds' referent justifications being classified as ambiguous or idiosyncratic significantly more often than those provided by 5-year-olds. There were no other significant effects or interactions, although the mode x age interaction approached significance, F (1, 104) = 3.20, $p < .10$.

Lastly, the "no justification" category accounted for 12% of referent justifications. While there were no significant main effects, there was a significant mode x sex interaction, F (1, 104) = 4.20, $p < .05$. The representational medium x mode x sex interaction approached significance, F (1, 104) = 3.40, $p < .10$. The significant mode x sex interaction associated with the "no justification" category is shown in Table 27. Males provided a higher proportion of "no justifications" for black and white as opposed to color pictures, whereas for females, the difference in

Table 26

Mean Proportion of Real Justifications for Referent Attributions by Representational Medium, Mode and Sex

	Representational Medium		
Mode/Sex	Prints	Slides	Total
Color			
Males	.54	.21	.39
Females	.35	.46	.41
Black & White			
Males	.25	.26	.25
Females	.50	.43	.46
Total	.40	.35	

Note. N = 120.

the proportion of "no justifications" elicited by the two conditions was negligible. Correspondingly, while females provided a slightly higher proportion of "no justifications" than males under the color condition, when black and white pictures were viewed, males provided a higher proportion of "no justifications" than females. Tukey HSD tests comparing the mean proportion of "no justifications" found no significant differences between the subgroups treated by this interaction.

To summarize, three major types of justifications were provided by children during the course of picture-referent questioning, each of which was associated with several sub-categories. Of children's reasons for attributing the properties of real objects to pictures, the content-related and "no justification" categories were found to be most frequent. While no main effects proved significant in either case, the content-related and the "no justification" categories were each associated with several significant two-way interactions. With respect to content-related justifications, whereby the child characterized a picture as he would a real world referent, analysis revealed that sex and age each independently interacted with pictorial mode. The significant mode x age interaction indicated that while 3-year-olds provided the same proportion of content-related justifications for iconic responses regardless of pictorial mode, 5-year-olds were more discriminative in that they tended to reserve their content-related justifications for color pictures. Correspondingly, the significant mode x sex interaction associated with content-related justifications indicated that the two sexes discriminated on the basis of pictorial mode, although

Table 27

Mean Proportion of No Justifications for Referent Attributions by Mode and Sex

	Mode		
Sex	Color	Black & White	Total
Males	.07	.19	.14
Females	.11	.09	.10
Total	.09	.14	

Note. N = 120.

this differentiation took different forms. Thus, females offered proportionately more content-related justifications than males for color pictures, with these findings reversed under the black and white condition, where males supplied more of these explanations than females. Similarly, with respect to the "no justification" category, the three significant two-way interactions involving mode, sex, and age demonstrated the combined influence of these variables on children's failure to justify iconic responses.

Of children's reasons for not attributing the properties of real objects to photographs, representational explanations were the most frequently used of the six non-iconic justification categories. Age was a significant factor here, with 5-year-olds providing representational justifications for their non-iconic responses proportionately more often than 3-year-olds. The next most frequently used non-iconic justification was the ambiguous/idiosyncratic category. This category was also significantly influenced by age, although the effect was the reverse of that associated with representational justifications. Thus, 3-year-olds' non-iconic justifications were classified as ambiguous or idiosyncratic proportionately more often than those offered by 5-year-olds.

Finally, of children's reasons for attributing properties or functions to referents, the content-related and real categories were the most commonly used. Of the two, content-related justifications might be considered the less sophisticated as emphasis was placed on properties and actions associated with one form (referent) whereas in real justifications, the explanation

entailed an implied, if not explicit, juxtaposition of both picture and object. As with children's total referent scores, both content-related and real justifications were significantly influenced by age and sex. Thus, 5-year-olds were proportionately more likely than 3-year-olds to offer "real" justifications, and females were proportionately more likely to provide such justifications than males. It should be recalled that 5-year-olds and females were also the groups associated with significantly higher total referent scores. In contrast, 3-year-olds were proportionately more likely to offer content-related justifications than 5-year-olds and males were more apt to provide such justifications than females. Again, content-related justifications were most commonly used by those groups having significantly lower total referent scores.

Intercorrelations Among Dependent Measures. The relationships between children's iconic realism, referent, and haptic picture scores and their associated subscores were computed by means of Pearson correlations, the results of which are reported in Table 28. For iconic realism, strong positive correlations were found between total iconic realism scores and each of the three subscores: functional (r =.52), existence (r =.69), and physical property (r =.88). Regarding the relationship of iconic subscores to each other, strong positive correlations occurred between physical and functional subscores (r =.43) and between existence and physical property subscores (r =.33), with only the correlation between functional and existence subscores departing from this general pattern. In terms of referent scores,

functional and physical property subscores were significantly and positively correlated with total referent scores (r =.53, .95, respectively) and with each other (r =.23). Lastly, with respect to children's haptic picture scores, the correlation between each subscore (functional, existence, physical property) and total haptic picture scores was both positive and highly significant (r =.85, .48, .92, respectively). The relationships between the various subscores were also positive and highly significant, with correlations ranging from r = .29 to .63.

In terms of correlations across different dependent measures, the relationship between iconic realism and referent scores, and their associated subscores, was generally low and nonsignificant, with the following exceptions. Significant negative correlations were found between functional iconic and functional referent subscores (r =-.36), and between functional iconic subscores and total referent scores (r =-.22).

While none of the correlations between haptic picture and iconic realism scores and their associated subscores proved significant, several relationships approached significance, and certain correlational patterns warrant comment. As examination of Table 28 reveals, the lowest correlations occurred between existence haptic subscores and total iconic scores and subscores. In contrast, the relationship of total haptic scores and physical property haptic subscores to total iconic scores and subscores was generally negative, with the exception of those correlations involving existence iconic subscores. Of the negative relationships, the correlation between physical property iconic and physical property haptic subscores approached significance (r

=-.13, p = .08) as did the correlation between physical property haptic and functional iconic subscores (r =-.13, p = .07).

Lastly, in terms of the relationship between referent and haptic picture scores, the correlations were generally low and nonsignificant, with the following exceptions. Significant negative correlations were found between existence haptic and physical property referent subscores (r =-.19), and between existence haptic subscores and total referent scores (r =-.16).

In order to obtain a clearer understanding of the relationship of these three dependent variables to each other, Pearson correlations were computed separately for subjects having one or more iconic responses ("iconic" subjects, N = 72) and for those without at least one iconic response ("non-iconic" subjects, N = 48). The intercorrelations pertaining to iconic subjects appear in Table 29. With respect to iconic realism, as in the case of the entire sample, strong positive correlations were found between total iconic realism scores and each subscore: functional (r =.46), existence (r =.69), physical property (r =.78). While the positive correlation between physical property and functional iconic subscores (r =.34) proved highly significant, the correlation between physical property and existence iconic subscores (r =.16), although positive, only approached significance, (p = .08). Again, as in the case of the entire sample, no significant relationship emerged between functional and existence iconic subscores.

In terms of children's referent scores, significant positive correlations were again found between total referent scores and

Table 28

Intercorrelations of Total Iconic Realism, Referent,

and Haptic Picture Scores and Subscores

Variables	IFS	IES	IPS	Icontot	RFS	RPS	Reftot	HFS	HES	HPS
IES	.05									
IPS	.43***	.33***								
Icontot	.52***	.69***	.88***							
RFS	-.36***	.09	-.05	-.07						
RPS	-.11	.10	.02	.03	.23**					
Reftot	-.22**	.12	.00	.01	.53***	.95***				
HFS	-.04	.12	.02	.06	.04	-.03	-.02			
HES	.01	.01	-.01	.00	.02	-.19*	-.16*	.29***		
HPS	-.13	.05	-.13	-.09	.10	.06	-.02	.63***	.30***	
Haptot	-.10	.08	-.07	-.03	.08	-.08	-.05	.85***	.48***	.92***

Note. N = 120; IFS = Functional Iconic Subscore; IES = Existence Iconic Subscore; IPS = Physical Property Iconic Subscore; Icontot = Total Iconic Realism Score; RFS = Functional Referent Subscore; RPS = Physical Property Referent Subscore; Reftot = Total Referent Score; HFS = Functional Haptic Subscore; HES = Existence Haptic Subscore; HPS = Physical Property Haptic Subscore; Haptot = Total Haptic Picture Score.

*$p < .05$ **$p < .01$ ***$p < .001$

both functional and physical property subscores (r =.49, .94 respectively). The correlation between functional and physical property referent subscores, although positive (r =.17), only approached significance (p = .07). Lastly, in terms of haptic picture scores, significant positive correlations ranging from r =.24 to .93 were found between each subscore, the total haptic score, and the other subscores, with correlations involving existence subscores not as highly positive as the others.

For correlations among different dependent variables, several significant relationships were found between measures involving iconic realism and referent knowledge. Functional iconic subscores evidenced a strong negative correlation with functional referent subscores (r =-.43) and a significant, although weak, negative correlation with total referent scores (r = -.22). In contrast, physical property iconic subscores showed a weak positive correlation with both physical property referent subscores (r =.23) and total referent scores (r =.20). Weak positive correlations also emerged between existence iconic subscores and total referent scores (r =.20).

For the relationship between measures involving iconic realism and haptic picture behavior, almost all of the correlations were negative, with the only correlations diverging from this pattern being those involving either existence iconic or existence haptic subscores. In contrast to what was reported for the entire subject sample, several significant correlations emerged. Physical property haptic subscores were negatively correlated with functional iconic subscores (r =-.20 $p < .05$), physical property iconic subscores (r =-.33 $p < .01$), and total

iconic subscores (r =-.22 p < .05). Total haptic picture scores were also found to be negatively correlated with physical property iconic subscores (r =-.29 p < .01).

Finally, as in the case of the entire subject sample, several significant relationships emerged between measures of haptic picture behavior and referent knowledge. Significant negative correlations were found between existence haptic and both physical property referent subscores (r =-.33) and total referent scores (r =-.29). Physical property haptic and functional referent subscores were found to be significantly correlated, but in a positive direction (r =.22).

The intercorrelations pertaining to non-iconic subjects appear in Table 30. As indicated, strong positive relationships were found between total referent scores and both functional and physical property subscores (r =.63, .95 respectively), with the correlations between the subscores somewhat smaller (r =.35). The same held true for haptic picture scores, where correlations between total scores and subscores ranged from r =.33 to .92. No relationships emerged between referent and haptic picture measures for this subset of the sample.

To summarize, correlations between iconic realism, referent knowledge, and haptic picture behavior were computed for the sample as a whole, and for iconic and non-iconic subgroups. For the entire sample as well as iconic subjects, strong positive associations were found between total iconic realism scores and each associated subscore. Of the iconic subscores, only functional and existence subscores failed to correlate positively

Table 29

Intercorrelations of Total Iconic Realism, Referent, and

Haptic Picture Scores and Subscores (Iconic Subjects)

Variable	IFS	IES	IPS	Icontot	RFS	RPS	Reftot	HFS	HES	HPS
IES	-.04									
IPS	.34**	.16								
Icontot	.46***	.69***	.78***							
RFS	-.43***	.14	-.01	-.05						
RPS	-.08	.18	.23*	.21*	.17					
Reftot	-.22*	.20*	.20*	.17	.49***	.94***				
HFS	-.11	.09	-.18	-.08	.11	-.01	.03			
HES	-.01	.00	-.10	-.06	.00	-.33**	-.29**	.25*		
HPS	-.20*	.04	-.33**	-.22*	.22*	-.12	-.03	.65***	.24*	
Haptot	-.17	.06	-.29**	-.18	.18	-.14	-.06	.86***	.43***	.93***

Note. N = 72, IFS = Functional Iconic Subscore; IES = Existence Iconic Subscore; IPS = Physical Property Subscore; Icontot = Total Iconic Realism Score; RFS = Functional Referent Subscore; RPS = Physical Property Referent Subscore; Reftot = Total Referent Score; HFS = Functional Haptic Subscore; HES = Existence Haptic Subscore; HPS = Physical Property Haptic Subscore; Haptot = Total Haptic Picture Score.

*$p < .05$ **$p < .01$ ***$p < .001$

Table 30

Intercorrelations of Total Referent and Haptic Picture Scores and Subscores (Non-Iconic Subjects)

Variable	RFS	RPS	Reftot	HFS	HES	HPS
RPS	.35**					
Reftot	.63***	.95***				
HFS	.08	.00	-.03			
HES	.06	.11	.11	.33**		
HPS	-.15	.11	.04	.59***	.41**	
Haptot	-.11	.08	.03	.83***	.56***	.92***

Note. N=48; RFS = Functional Referent Subscore; RPS = Physical Property Referent Subscore; Reftot = Total Referent Score; HFS = Functional Haptic Subscore; HES = Existence Haptic Subscore; HPS = Physical Property Haptic Subscore; Haptot = Total Haptic Picture Score.

**$p < .01$ *** $p < .001$

with each other, suggesting that iconic responses to these question types occurred independently.

For all three groups, referent subscores were positively correlated with both total referent scores and with each other. With respect to haptic picture behavior, the three haptic subscores were again positively correlated with the total haptic score, and with each other, although those correlations involving existence subscores were not as highly positive as the others. This tendency was seen most clearly with respect to iconic subjects, and most probably reflected the fact that less manipulation was elicited by this question type in comparison to the others.

For the relationship between iconic realism and referent knowledge, findings on the sample as a whole and for the iconic subjects were generally low and nonsignificant, with the exception of significant negative correlations between functional iconic subscores, and both total referent scores and functional referent subscores. In addition to the aforementioned negative correlations, several positive relationships emerged when iconic subjects alone were considered. Moderate positive correlations were found between the following pairs: physical property iconic subscores and total referent scores; physical property iconic and physical property referent subscores; existence iconic subscores and total referent scores.

In terms of the correlations between iconic realism and haptic picture behavior, certain relationships merely suggested by data on the entire subject population proved significant when iconic subjects alone were considered. Physical property haptic

subscores were negatively correlated with functional iconic subscores, physical property iconic subscores, and total iconic subscores. Total haptic picture scores were also found to be negatively correlated with physical property iconic subscores.

Lastly, for both the entire subject sample and iconic subjects, the correlations between referent and haptic picture scores were generally low and nonsignificant, with the following exceptions. Significant negative correlations were found between existence haptic and physical property referent subscores, and between existence haptic subscores and total referent scores. For iconic subjects, functional referent and physical property haptic subscores were also positively correlated. No relationships emerged between referent and haptic picture measures for non-iconic subjects.

Phase II: Counter-Iconic Challenges

In this phase, children with one or more iconic responses ("iconic" subjects, N = 72) were purposely challenged with information contrary to their belief in iconic realism, whereas children without at least one iconic response ("non-iconic" subjects, N = 48) were excluded. A breakdown of the number of subjects who participated in the two phases grouped by representational medium, mode, age and sex is presented in Table 31.

Residual Iconic Realism. As in the case of picture-referent questioning, the counter-iconic challenges were structured in terms of the three question types, with the exception that existence challenges were differentiated into "expected" and

"actual" phases. In the "expected" segment of the challenge, the child performed an action on either the picture or the referent, and had to anticipate if anything happened to its counterpart. This was followed by the "actual" phase where the child actually witnessed the outcome of these actions. In scoring all three question types, each response was treated as a unit and one point was credited for each affirmative answer or spontaneous attribution of the property of a real object to a photograph. As in Phase I, children sometimes changed their responses during questioning and when this occurred, the child's final indication of his belief was the one that was scored. The number of "I don't knows" and ambiguous responses were also noted. Sometimes children refused to perform the action (e.g., touching the picture) that would constitute the counter-iconic challenge, and the number of times this occurred was also recorded. Finally, as may be recalled, physical property challenges consisted of two parts. First, the child tested the picture, and decided if an attributed property (e.g., coldness) was present in the representation. If the child responded affirmatively or spontaneously attributed the property of the real object to the photograph, the child was then asked if he felt that the property was present in the picture to the same extent as in the real world referent (e.g., does the picture of the ice cream cone feel as cold as ice cream from the candy store?). These two-part questions were scored as follows. If the child responded affirmatively to both parts, he was credited for the question. If the child responded negatively to the initial question, he was not questioned further, and did not receive credit for that item.

Table 31

Number of Subjects as a Function of Phase Participation, Representational Medium, Mode, Age and Sex

	Phase Participation		
	I and II	I only	N
Representational Medium			
Prints	34	26	60
Slides	38	22	60
Mode			
Color	36	24	60
Black and White	36	24	60
Age			
3 Years	51	9	60
5 Years	21	39	60
Sex			
Males	31	23	54
Females	41	25	66

A number of subjects responded affirmatively to the first question, yet did not feel that the picture possessed the quality in question (e.g., coldness) to the same extent as the referent. When this occurred, the child was categorized as "quasi" for that item.

In analyzing children's responses to the counter-iconic challenges, the following five measures were devised to indicate the amount of "residual" iconic realism remaining once the counter-iconic challenges were completed:

1. Residual Functional Subscore. This subscore was based on the total number of affirmative responses to functional challenges.

2. Residual "Expected" (Existence) Subscore. This subscore was based on the number of affirmative responses to that portion of the existence challenge where the child performed an action on either the picture or the referent and then was asked to anticipate if anything had happened to its counterpart.

3. Residual "Actual" (Existence) Subscore. This subscore was based on the number of affirmative responses to that part of the existence challenge where the child actually witnessed the outcome of his or the experimenter's actions on either the picture or the object.

4. Residual Physical Property Subscore. This subscore was based on the total number of affirmative responses or spontaneous iconic attributions to the physical property challenges.

5. Total Residual Iconic Realism Score. The total score was based on the sum of affirmative responses or spontaneous iconic attributions to functional, actual (existence), and physical

property challenges.

The means and standard deviations for total residual iconic scores and subscores are presented in Table 32. Four-way analyses of variance were performed on these scores, the results of which are summarized here. For comparison purposes, the means and standard deviations for total iconic scores and subscores obtained by iconic subjects during Phase I can be found in Table 33. The corresponding ANOVAS appear in Table A. It should be noted that, in the presentation which follows, the percentages were based on mean proportions computed for iconic subjects.

In terms of total residual iconic realism, the overall mean was .99, indicating that, on the whole, 30% of the total iconic realism originally elicited during Phase I ($\overline{X}$ = 3.90) remained after the counter-iconic challenges. There were no significant effects or interactions associated with total residual iconic realism scores.

For residual functional iconic subscores, there were no functional iconic responses remaining after the counter-iconic challenges. Thus, when children are actually confronted with using a picture to fulfill the functions of its real world referent, they deny that this can be done. For residual "expected" subscores, the overall mean was .50, indicating that approximately 53% of the iconic realism originally elicited in response to existence questions in Phase I ($\overline{X}$ = .82) remained following the anticipatory phase of the existence challenge. Representational medium proved significant, F (1,56) = 7.10, p < .01, indicating that slides were more than nine times more

Table 32

Means and Standard Deviations of Total Residual Iconic Realism Scores and Subscores for Representational Medium x Mode x Age x Sex Conditions

	Rep. Medium		Mode		Age		Sex	
	Prints (N=34)	Slides (N=38)	Color (N=36)	Black & White (N=36)	3 Years (N=51)	5 Years (N=21)	Males (N=31)	Females (N=41)
Total Residual Iconic Realism Score								
Mean	1.00	.97	1.06	.92	1.06	.81	.97	1.00
SD	1.10	.94	1.09	.94	1.07	.87	.95	1.07
Residual Expected (Exist.) Subscore								
Mean	.09	.87	.69	.31	.67	.10	.45	.54
SD	.29	1.54	1.43	.89	1.38	.30	.99	1.34
Residual Actual (Exist.) Subscore								
Mean	.03	.08	.08	.03	.08	.00	.00	.10
SD	.17	.27	.28	.17	.27	.00	.00	.30
Residual Physical Property Subscore								
Mean	.97	.89	.97	.89	.98	.81	.97	.90
SD	1.11	.89	1.08	.92	1.05	.87	.95	1.04

Note. The means and standard deviations for "I don't know", ambiguous, and quasi responses were .06 (SD = .28, 17 (SD = .44), and .24 (SD = .49), respectively. The mean and standard deviation for the number of instances on which children refused to perform the counter-iconic challenge was .08 (SD = .32).

Table 33

Means and Standard Deviations of Total Iconic Realism Scores and Subscores for Representational Medium x Mode x Age x Sex Conditions (Iconic Subjects, Phase I)

	Rep. Medium		Mode		Age		Sex	
	Prints (n=34)	Slides (n=38)	Color (n=36)	Black & White (n=36)	3 Years (n=51)	5 Years (n=21)	Males (n=31)	Females (n=41)
Total Iconic Realism Score								
Mean	3.29	4.45	3.92	3.89	4.24	3.10	3.74	4.02
SD	2.17	3.08	2.83	2.67	3.04	1.58	2.87	2.65
Functional Subscore								
Mean	.38	.34	.31	.42	.39	.29	.32	.39
SD	.85	.75	.67	.91	.83	.72	.60	.92
Existence Subscore								
Mean	.26	1.32	.97	.67	1.04	.29	.84	.80
SD	.75	2.04	1.80	1.49	1.83	.90	1.73	1.60
Physical Property Subscores								
Mean	2.65	2.79	2.64	2.81	2.80	2.52	2.58	2.83
SD	1.43	1.73	1.64	1.55	1.60	1.57	1.36	1.74

likely than prints to be associated with residual "expected" iconic realism. There were no other significant effects or interactions pertaining to residual "expected" iconic realism.

In contrast to residual "expected" iconic realism, the overall mean for residual "actual" iconic realism was .06, indicating that, on the whole, 8% of the iconic realism originally elicited in response to existence questions ($\overline{X}$ = .82) remained after the second segment of the existence challenge. There were no significant effects or interactions associated with residual "expected" subscores.

The overall mean for residual physical property subscores was .93, indicating that, on the whole, 37% of the iconic realism originally elicited in response to physical property questions in Phase I ($\overline{X}$ = 2.72) remained after the physical property challenges. There were no significant effects or interactions associated with residual physical property subscores, although the representational medium x mode x sex x age interaction approached significance, $\underline{F}$ (1,56) = 2.85, $\underline{p}$ <.10.

Finally, while the preceding findings were concerned with effects within individual counter-iconic challenges on the tendency to engage in iconic realism, this final group of analyses deals with comparison across challenges. As indicated earlier, physical property challenges were associated with the most residual iconic realism, followed by actual (existence) and functional challenges, respectively. Correlated t-tests performed on mean residual iconic realism scores indicated that residual physical property iconic realism ($\overline{X}$ = .93) differed significantly from both residual actual (existence) ($\overline{X}$ = .06) and residual

functional iconic realism ($\overline{X}$ = .00) at the .001 level. The remaining comparison between residual functional ($\overline{X}$ = .00) and residual actual (existence) iconic realism ($\overline{X}$ = .06) was significant at the .05 level.

In summary, analysis of "residual" iconic realism following the counter-iconic challenges indicated substantial iconic realism remained despite a reduction in the tendency to engage in iconic realism. The effect of exposure to physical evidence contrary to the belief in iconic realism varied with the question type. While a small amount of iconic realism was elicited in response to functional questions during Phase I, no residual functional iconic realism remained after the counter-iconic challenges. Thus, when children are actually confronted with using a picture to fulfill the functions of its real world referent, they deny that this can be done. In contrast, for residual physical property iconic realism, a substantial 37% of the iconic realism originally elicited in response to physical property questions in Phase I remained following the counter-iconic challenges. There were no significant effects or interactions associated with residual physical property subscores.

The most intriguing consequence of the counter-iconic challenges was seen in conjunction with the two-part existence challenges. As examination of the data on iconic subjects (Tables 33 and A) reveals, this subgroup was more homogeneous than the sample as a whole. One of the few significant effects that remained when the Phase I performance of iconic subjects alone

was considered was the effect of representational medium associated with existence questions. It is just this result that was reflected in the significant effect associated with the residual "expected" (existence) subscore. Thus, as in Phase I, when asked to anticipate the results of their actions on either a picture or an object, children were significantly more likely to engage in iconic realism with slides than photographic prints. However, once the consequences of their actions on either the picture or the object were observed, representational medium no longer had a differential effect as reflected in the findings pertaining to the residual "actual" (existence) subscore. There were no significant effects or interactions associated with this portion of the existence challenge.

In comparisons among counter-iconic challenges, physical property challenges were associated with the most residual iconic realism, followed by actual (existence) and functional challenges, respectively. This pattern echoes the findings obtained in Phase I with respect to the amount of iconic realism elicited by the various question types. Lastly, results associated with total residual iconic realism indicated that, as a whole, 30% of the iconic realism originally elicited during Phase I remained following the counter-iconic challenges.

Justifications. Three types of justifications were provided by children during the course of the counter-iconic challenges: (1) reasons for attributing the properties of real objects to photographs ("iconic" justifications) (2) reasons for not attributing the properties of real objects to photographs ("non-iconic" justifications) and (3) explanations associated with

quasi responses. The same classification system applied to justifications in Phase I was used here, with a few changes. Details were only provided in the case of categories not described earlier with respect to Phase I.

1. Iconic Justifications

   (a) Content-Related

   (b) Reciprocal

   (c) Ambiguous/Idiosyncratic

   (d) No Justification

2. Non-Iconic Justifications

   (a) Representational

   (b) Partial

   (c) Ambiguous/Idiosyncratic

   (d) No Justification

   (e) Faulty Challenge. This category applied exclusively to existence challenges. The child rationalized the fact that destroying the picture or the referent did not affect its counterpart on the belief that the experimenter failed to perform the operation properly. For example, when asked to explain why nothing happened to the picture of the crayon once its referent was broken in two, one 3-year-old replied, "Because you didn't put it next to it and broke (sic) it. I know when I watched you ... before you broke it, I told you to put it here."

3. Quasi Justifications

These justifications were elicited in response to physical property challenges in cases where the child attributed the property of a real object to a picture yet did not feel that the

picture possessed the property in question to the same extent as the real object. Although presented here, these categories were not subjected to analysis due to the small number of cases to which they applied.

(a) Representational. As in the case of non-iconic responses, the child justified his quasi response by making reference to the fact that photographs are only representations of objects and therefore not equivalent to real world referents. For example, when asked why the picture of a banana wouldn't smell as good as the referent, one child, age 3-6, responded, "Cause it's a picture and that isn't."

(b) Ambiguous/Idiosyncratic. Either the meaning behind the child's explanation remained unclear despite probing, or the child made reference to some irrelevant, idiosyncratic notion in support of his quasi response. For example, when asked to explain why the flame on the picture of a candle would not feel as hot as that on a candle on a birthday cake, one 3-year-old could only reply, "Because it's not supposed to ... because it can't."

(c) No Justification. The child explicitly indicated that he could not justify his quasi response, or simply made no effort to do so, even upon probing by the experimenter.

In scoring, a child was credited with one point for each classifiable explanation. Children sometimes changed their responses during questioning, and when this occurred, the child's final justification was the one that was scored. As a reliability check, an independent rater was briefed regarding the system of classification and re-categorized 25% of the protocols, chosen randomly. The percentage of agreement between the classifications

made by the experimenter and the rater was 95% (out of 73 categorizations).

In analyzing iconic justifications elicited in response to counter-iconic challenges, for each category, the child was assigned the proportion that that category (e.g., content-related) represented of the total number of iconic responses given by the child during Phase II. Subjects without any iconic responses were therefore excluded. The means and standard deviations for the categories of iconic justifications appear in Table 34. Four-way analyses of variance, Representational Medium (Prints, Slides) x Mode (Color, Black and White) x Sex (Male, Female) x Age (3 Years, 5 Years), were performed on these proportions. As indicated, only partial results were available with respect to these ANOVAS as higher-order interactions were suppressed due to empty cells. It should be noted that, in the presentation which follows, the percentages are based on mean proportions.

As in Phase I, content-related justifications (overall mean = .40) again represented the most frequently used iconic justification. There were no significant effects or interactions associated with content-related justifications. The only relevant finding was a sex x age interaction which approached significance, F (1,32) = 3.31, p <.10.

In contrast to content-related justifications, reciprocal justifications, the notion that destroying a photograph or an object affects its counterpart, were the most infrequently used iconic justification. On the whole, reciprocal justifications

Table 34

Means and Standard Deviations of Proportions of Iconic Justifications for Representational Medium x Mode x Age x Sex Conditions (Phase II)

Justifications	Rep. Medium		Mode		Age		Sex	
	Prints (n=19)	Slides (n=24)	Color (n=22)	Black & White (n=21)	3 Years (n=32)	5 Years (n=11)	Males (n=18)	Females (n=25)
Content-Related								
Mean	.39	.40	.45	.34	.39	.41	.44	.37
SD	.43	.46	.44	.45	.43	.49	.48	.42
Reciprocal								
Mean	.00	.02	.00	.02	.02	.00	.00	.02
SD	.00	.10	.00	.11	.09	.00	.00	.10
Ambiguous/Idiosyn.								
Mean	.12	.19	.09	.23	.21	.00	.14	.17
SD	.27	.38	.25	.40	.38	.00	.29	.37
No Justification								
Mean	.38	.33	.32	.38	.27	.59	.40	.31
SD	.43	.45	.40	.47	.39	.49	.48	.41

Note. Each category was assigned the proportion that it represented of the total residual iconic realism score. Proportions may not total 1.00 in all instances due to missing cases.

accounted for only 1% of iconic justifications. There were no significant effects or interactions associated with reciprocal justifications.

Ambiguous/idiosyncratic justifications accounted for 9% of all iconic justifications elicited in response to counter-iconic challenges. There were no significant effects or interactions associated with this justification category. The only effect to approach significance was that of age, $\underline{F}$ (1, 32) = 2.93, $\underline{p} < .10$, with 3-year-olds' iconic justifications proportionately more likely to be categorized as ambiguous or idiosyncratic than those provided by 5-year-olds.

Lastly, as in Phase I, the "no justification" category represented the second most frequently given iconic justification, accounting for 35% of iconic justifications. The effect of age was significant, $\underline{F}$ (1, 32) = 5.55, $\underline{p} < .05$. There was also a significant sex x age interaction, $\underline{F}$ (1, 32) = 8.21, $\underline{p} < .01$. The main effect for age indicates that, of the two groups, 5-year-olds were proportionately more likely to offer no justification for their iconic responses. The age x sex interaction, illustrated in Table 35, indicated that while for females, 5-year-olds were proportionately more likely than 3-year-olds to offer no justification for their iconic responses, the age effect was reversed with respect to males. Correspondingly, while at the 3-year-old level, males were proportionately more likely than females to fail to justify an iconic response, for 5-year-olds, females were proportionately more likely to exhibit such a tendency. Scheffé post hoc analyses comparing the mean proportion of no justifications for

iconic responses revealed that 3-year-old females differed significantly from 5-year-old females at the .05 level. There were no other significant comparisons between the subgroups treated by this interaction.

In analyzing non-iconic justifications elicited in response to counter-counter challenges, for each category, the child was assigned the proportion that that category (e.g., partial) represented of the total number of non-iconic responses given by the child during Phase II. Subjects without any non-iconic responses were therefore excluded. The means and standard deviations for the categories of non-iconic justifications appear in Table 36. Four-way analyses of variance, Representational Medium (Prints, Slides) x Mode (Color, Black and White) x Sex (Male, Female) x Age (3 Years, 5 Years), were performed on these proportions. It should be noted that, in the presentation which follows, the percentages are based on mean proportions.

As in Phase I, representational justifications (overall mean = .49) were the most frequently used non-iconic justification. While there were no significant main effects associated with this justification category, the mode x sex x age interaction proved significant, F (1,40) = 5.74, $p < .05$. There were no other significant interactions, although the representational medium x sex, the mode x sex, and the sex x age interactions all approached significance, F (1,40) = 3.66, $p < .10$, F (1,40) = 3.21, $p < .10$, and F (1,40) = 3.62, $p < .10$, respectively. The significant mode x sex x age interaction

Table 35

Mean Proportion of No Justifications for Iconic Responses by Age and Sex (Phase II)

	Age		
Sex	3 Years	5 Years	Total
Males	.43	.33	.40
Females	.17	.90	.31
Total	.27	.59	

Note. N = 43.

Table 36

Means and Standard Deviations of Proportions of Non-Iconic Justifications for Representational Medium x Mode x Age x Sex Conditions (Phase II)

Justifications	Rep. Medium		Mode		Age		Sex	
	Prints (n=24)	Slides (n=32)	Color (n=28)	Black & White (n=28)	3 Years (n=40)	5 Years (n=16)	Males (n=24)	Females (n=32)
Representational								
Mean	.44	.53	.48	.50	.50	.48	.50	.48
SD	.43	.43	.43	.43	.41	.49	.44	.42
Partial								
Mean	.06	.05	.10	.01	.05	.08	.09	.03
SD	.22	.14	.24	.05	.14	.25	.24	.11
Ambiguous/Idiosyncratic								
Mean	.26	.20	.19	.26	.28	.09	.17	.27
SD	.37	.30	.31	.35	.34	.26	.30	.35
No Justification								
Mean	.24	.20	.21	.22	.16	.35	.24	.20
SD	.41	.28	.33	.35	.27	.45	.38	.31
Faulty Challenge								
Mean	.00	.02	.02	.00	.02	.00	.00	.02
SD	.00	.08	.08	.00	.07	.00	.00	.08

Note. Each category was assigned the proportion that it represented of the total number of non-iconic responses elicited during Phase II.

associated with representational justifications is shown in Table 37. For male 3-year-olds, a higher proportion of representational justifications was elicited by black and white ($\overline{X}$ = .59) as opposed to color pictures ($\overline{X}$ = .13), whereas for female 3-year-olds, a higher proportion of representational justifications was elicited by color pictures ($\overline{X}$ = .66). In contrast, at the 5-year-old level, while females provided proportionately more representational justifications for black and white ($\overline{X}$ = .60) as opposed to color pictures ($\overline{X}$ = .20), for males, there was only a slight difference in the proportion of representational justifications elicited by color and black and white modes ($\overline{X}$ = .67 and .58, respectively). Correspondingly, for both age groups, sex differences were generally greater under the color condition as opposed to the black and white condition, with the smallest differential between the sexes occurring for 5-year-olds in the black and white condition. Tukey HSD tests indicated that the proportion of representational justifications provided by male 3-year-olds in the color condition differed significantly from that provided by female 3-year-olds in the color condition at the .01 level. There were no other significant subgroup comparisons.

Partial justifications, whereby a child attempted to give some indication of the intangibility of objects depicted in pictures or of the non-reciprocality of actions performed on one form to another, represented 6% of non-iconic justifications. The main effect of mode proved significant, F (1,40) = 5.09, $p < .05$, with color pictures eliciting a higher proportion of partial justifications than their black and white counterparts.

Table 37

Mean Proportion of Representational Justifications for Non-Iconic Responses by Mode, Sex and Age (Phase II)

	Mode		
Age/Sex	Color	Black & White	Total
3 Years			
Males	.13	.59	.44
Females	.66	.34	.53
5 Years			
Males	.67	.58	.61
Females	.20	.60	.31
Total	.48	.50	

Note. N = 56

While there were no other significant main effects, sex approached significance, F (1,40) = 3.01, $p < .10$. The proportion of partial justifications provided by males was therefore somewhat higher than that given by females. While there were no significant interactions, the mode x sex interaction approached significance, F (1,40) = 2.87, $p < .10$ as did the representational medium x mode x sex x age interaction, F (1,40) = 3.13, $p < .10$.

The ambiguous/idiosyncratic category accounted for 22% of non-iconic justifications. Age proved significant, F (1,40) = 4.34, $p < .05$. The representational medium x age and the mode x sex interactions both proved significant, F (1, 40) = 5.92, $p < .05$ and F (1,40) = 4.33, $p < .05$, respectively. Lastly, the mode x sex x age interaction proved significant, F (1,40) = 6.20, $p < .05$. The significant effect for age associated with the ambiguous/idiosyncratic category indicated that a higher proportion of the non-iconic justifications provided by 3-year-olds were found to be ambiguous or idiosyncratic than those provided by 5-year-olds. The significant representational medium x age interaction is illustrated in Table 38. While at the 3-year-old level, a higher proportion of ambiguous/ idiosyncratic justifications was elicited by prints as opposed to slides, at the 5-year-old level, slides elicited a higher proportion of such justifications than prints. Correspondingly, while the proportion of ambiguous/idiosyncratic justifications declined with age when prints alone were considered, an almost identical proportion of ambiguous/idiosyncratic justifications was provided by the two age groups under the slide condition. Tukey HSD tests indicated

that the proportion of ambiguous/idiosyncratic justifications provided by 5-year-olds in the print condition differed from that provided by 3-year-olds in both slide and print conditions at the .01 level. There were no other significant subgroup comparisons.

The significant mode x sex interaction associated with the ambiguous/idiosyncratic category is illustrated in Table 39. While, for males, a higher proportion of ambiguous/idiosyncratic justifications was elicited by color than black and white pictures, the reverse proved true with respect to females, who provided a higher proportion of these justifications for black and white as opposed to color pictures. Correspondingly, a greater differential between the sexes emerged under the black and white condition than under the color condition. Tukey HSD tests comparing the mean proportion of ambiguous/idiosyncratic justifications provided by the various subgroups treated by the interaction revealed no significant differences.

Lastly, the mode x sex x age interaction associated with the ambiguous/idiosyncratic category is illustrated in Table 40. With respect to 3-year-olds, a higher proportion of ambiguous/idiosyncratic justifications was provided by males when color as opposed to black and white pictures were viewed. In contrast, for females, a higher proportion of such justifications was elicited by black and white pictures. Males provided a higher proportion of ambiguous/idiosyncratic justifications than females under the color condition, with these findings being reversed when black and white pictures were the representational mode under

Table 38

Mean Proportion of Ambiguous/Idiosyncratic Justifications for Non-Iconic Responses by Representational Medium and Age (Phase II)

	Representational Medium		
Age	Prints	Slides	Total
3 Years	.39	.20	.28
5 Years	.00	.18	.09
Total	.26	.20	

Note. N = 56.

Table 39

Mean Proportion of Ambiguous/Idiosyncratic Justifications for Non-Iconic Responses by Mode and Sex (Phase II)

	Mode		
Sex	Color	Black & White	Total
Males	.24	.13	.17
Females	.16	.43	.27
Total	.19	.26	

Note. N = 56.

consideration. In contrast, at the 5-year-old level, much more consistency was seen across sex and pictorial mode. No ambiguous/idiosyncratic justifications were provided by three subgroups, with only 5-year-old females in the color condition deviating from this pattern. Tukey HSD tests comparing the mean proportion of ambiguous/idiosyncratic justifications indicated that 3-year-old females in the black and white condition differed significantly from 5-year-old males in the color condition, and from 5-year-old males and females in the black and white condition. These differences were significant at the .01 level. There were no other significant subgroup comparisons.

The "no justification" category also accounted for 22% of non-iconic justifications. Age proved significant, F (1, 40) = 4.81, $p < .05$. Both the representational medium x age, and the sex x age interaction proved significant, F (1,40) = 4.82, $p < .05$ and F (1,40) = 6.32, $p < .05$, respectively. The representational medium x mode x sex and the representational medium x mode x age interactions also proved significant, F (1,40) = 10.59, $p < .01$ and F (1,40) = 4.96, $p < .05$, respectively. There were no other significant effects or interactions, although the representational medium x mode x sex x age interaction approached significance, F (1,40) = 3.86, $p < .10$. The main effect for age indicated that 5-year-olds were proportionately more likely than 3-year-olds to fail to justify a non-iconic response during Phase II. The significant representational medium x age interaction is illustrated in Table 41. While, on the whole, 5-year-olds were proportionately more likely than 3-year-olds to fail to justify a non-iconic

Table 40

Mean Proportion of Ambiguous/Idiosyncratic Justifications for Non-Iconic Responses by Mode, Age, and Sex (Phase II)

	Mode		
Age/Sex	Color	Black & White	Total
3 Years			
Males	.38	.21	.27
Females	.13	.52	.28
5 Years			
Males	.00	.00	.00
Females	.28	.00	.20
Total	.19	.26	

Note. N = 56.

response, as can be seen, this finding actually applied only to subjects viewing photographic prints. There was virtually no difference in the proportion of "no justifications" provided by the two age groups under the slide condition. Correspondingly, for 3-year-olds, a slightly higher proportion of "no justifications" occurred for slides than for prints. In contrast, for 5-year-olds, a higher proportion of "no justifications" was provided under the print as opposed to the slide condition, with a much larger difference emerging between these two representational media than at the 3-year-old level. Tukey HSD tests revealed no significant differences in the mean proportion of "no justifications" provided by the subgroups treated by this interaction.

The significant sex x age interaction associated with the "no justification" category is illustrated in Table 42. While, on the whole, 5-year-olds were proportionately more apt to fail to justify a non-iconic response, in actuality this finding only held true with respect to females. There was virtually no difference in the mean proportion of "no justifications" provided by males at the two age levels. In terms of sex differences within a given age group, at the 3-year-old level, a higher proportion of "no justifications" was provided by males than females. In contrast, with respect to 5-year-olds, a higher proportion of "no justifications" was provided by females, with a greater differential emerging between the sexes than at the 3-year-old level. Tukey HSD tests comparing the mean proportion of "no justifications" provided by the various subgroups found no significant differences.

Table 41

Mean Proportion of No Justifications for Non-Iconic Responses by Representational Medium and Age (Phase II)

	Representational Medium		
Age	Prints	Slides	Total
3 Years	.10	.20	.16
5 Years	.50	.21	.35
Total	.24	.20	

Note. N = 56.

The significant representational medium x mode x sex interaction associated with the "no justification" category is illustrated in Table 43. With respect to the color condition, males provided a higher proportion of "no justifications" for slides whereas females provided a higher proportion of "no justifications" for prints. In terms of sex differences within the color condition, the differential between the sexes was somewhat greater when prints as opposed to slides were viewed. The results with respect to the black and white condition also showed considerable variation. Males in the black and white condition provided a higher proportion of "no justifications" for prints whereas females provided a higher proportion of "no justifications" for slides. Again, a greater differential between the sexes emerged under the print than under the slide condition. Tukey HSD tests comparing the mean proportion of "no justifications" revealed no significant differences between the subgroups treated by this interaction.

Lastly, the significant representational medium x mode x age interaction associated with the "no justification" category is illustrated in Table 44. For both the color and black and white conditions, 5-year-olds provided a higher proportion of "no justifications" than 3-year-olds when viewing photographic prints. Five-year-olds also provided a higher proportion of "no justifications" for prints as opposed to slides regardless of pictorial mode. In contrast, while 3-year-olds in the color condition provided a higher proportion of "no justifications" for slides than prints, under the black and white condition, the same age group evidenced no difference in the proportion of "no

Table 42

Mean Proportion of No Justifications for Non-Iconic Responses by Sex and Age (Phase II)

Sex	Age		Total
	3 Years	5 Years	
Males	.24	.25	.24
Females	.12	.49	.20
Total	.16	.35	

Note. N = 56.

Table 43

Mean Proportion of No Justifications for Non-Iconic Responses by Representational Medium, Mode and Sex (Phase II)

	Representational Medium		
Mode/Sex	Prints	Slides	Total
Color			
Males	.00	.32	.20
Females	.26	.18	.22
Black and White			
Males	.52	.11	.26
Females	.03	.30	.17
Total	.24	.20	

Note. N = 56.

justifications" elicited by the two representational media. Lastly, while for the color condition, 3-year-olds provided a somewhat higher proportion of "no justifications" than 5-year-olds when slides were viewed, the reverse proved true under the black and white condition, where 5-year-olds provided a somewhat higher proportion of these justifications than 3-year-olds for slides. Tukey HSD tests comparing the mean proportion of "no justifications" provided by the various subgroups revealed no significant differences.

"Faulty challenge" justifications, whereby a child attributed his non-iconic response to the experimenter's failure to perform the counter-iconic challenge operation correctly, were the most infrequently used non-iconic justification. On the whole, faulty challenge justifications accounted for only 1% of non-iconic justifications. There were no significant effects or interactions associated with this justification type.

In summary, this section focused on the type of justifications provided for both iconic and non-iconic responses during the course of the counter-iconic challenges. In terms of children's reasons for attributing the properties of real objects to pictures, with the exception of the "no justification, unprobed" category which did not apply in Phase II, each justification category accounted for approximately the same proportion of iconic justifications as it did in Phase I. The content-related and "no justification" categories were again found to be most popular. While there were no significant effects or interactions associated with content-related justifications, the proportion of "no justifications" was significantly affected

Table 44

Mean Proportion of No Justifications for Non-Iconic Responses by Representational Medium, Mode, and Age (Phase II)

Mode/Age	Representational Medium		
	Prints	Slides	Total
Color			
3 Years	.04	.25	.16
5 Years	.50	.15	.32
Black and White			
3 Years	.16	.16	.16
5 Years	.50	.26	.38
Total	.24	.20	

Note. N = 56.

by age, with 5-year-olds being the more likely of the two age groups to offer no justification for their iconic responses. The sex x age interaction further elaborated on this finding, indicating that while this age effect held true for females, the reverse proved true with respect to males.

In terms of children's reasons for not attributing the properties of real objects to pictures, as in Phase I, representational justifications were the most frequently used of the five non-iconic justification categories. While there were no main effects associated with this justification category, a significant three-way interaction revealed that the proportion of representational justifications varied as a function of mode, sex and age. Ambiguous/idiosyncratic justifications and the "no justification" category were the next most frequently used categories of non-iconic justification. Both were associated with a significant main effect for age, and a number of significant two-and three-way interactions. In the case of ambiguous/ idiosyncratic justifications, the main effect for age indicated that a higher proportion of the non-iconic justifications provided by 3-year-olds than 5-year-olds were categorized as ambiguous or idiosyncratic. The significant representational medium x age interaction elaborated on this finding by revealing that while the proportion of such justifications declined with age under the print condition, under the slide condition there was virtually no difference between the two age groups. The significant mode x sex interaction indicated that while males provided a higher proportion of ambiguous/idiosyncratic justifications for color pictures, females provided a higher

proportion of such explanations for black and white pictures. The combined influence of age, sex, and mode on ambiguous/ idiosyncratic justifications was specified even further by a significant interaction involving all three variables.

As in the case of ambiguous/idiosyncratic justifications, the "no justification" category was associated with a significant effect for age, although here 5-year-olds were more likely than 3-year-olds to fail to justify a non-iconic response following a counter-iconic challenge. The significant representational medium x age interaction elaborated on this finding by indicating that the age effect actually applied only to subjects in the photographic print condition, as virtually no difference existed between the two age groups in the proportion of "no justifications" provided under the slide condition. The significant sex x age interaction also elaborated on the age effect by indicating that age difference actually held only with respect to females, with virtually no difference emerging between the mean proportion of "no justifications" provided by males at the two age levels. Finally, the combined influence of representational medium, mode, sex and age on the "no justification" category was specified even further by the significant representational medium x mode x sex and representational medium x mode x age interactions.

Phase III: Photographic Knowledge Questions

In contrast to Phase II, all subjects participated in the final phase of the study, responding to a series of questions concerning their experience and familiarity with the photographic

medium. For the classification system employed here, all the protocols were first examined, resulting in several categories for each question type. These categories were then revised as application to the data required. The categories for each question, the percentage of subjects that chose each category, and the criteria for assigning points for correct responses are described in Appendix C . While the categories themselves were provided by the subjects, points were credited for answers generally viewed as correct by adults. Some questions were designed to gauge children's exposure to the photographic medium, with responses indicative of greater experience receiving credit (e.g., affirmative responses to "Have you ever used a camera?" or "Besides the pictures we talked about today, have you ever seen any other photographs like this?") The maximum number of points attainable for an individual question varied from 1 to 4. In cases where there was a single correct answer, 1 point was credited (e.g., when asked, "Which would look more like a truck, a drawing you made of the truck or a photograph of the truck," photograph is the only correct response). In contrast, for some questions a number of correct alternatives existed and two or more of these were often combined within a single explanation. For example, when asked how a watch in a picture is different from a real watch, some children cited a single difference (e.g., function) while others mentioned several differences (e.g., "Because it's not real and when you want to listen to it, it wouldn't sound like anything and you couldn't wear it like a real watch.") Children received 1 point for each response category mentioned, the example above receiving 3 points. The maximum

number of points attainable for a correct answer also varied on the four question series probing children's understanding of the origin of photographs. A correct response(i.e., camera) to the initial question received 4 points, a correct response to the second probe received 3 points, and so on. As a reliability check, an independent rater was briefed regarding the system of classification and re-categorized 25% of the protocols, chosen randomly. The percentage of agreement between the classification made by the experimenter and the rater was 90% (out of 326 classifications).

In analyzing these responses, each child was assigned a proportion that represented the total number of points accumulated for correct responses of the total number of possible points. The total number of potential points was based on an ideal of 31 (attainable if the child received the maximum score for each question), and was adjusted to account for missing cases. The means and standard deviations for these photographic knowledge proportions appear in Table 45. The overall mean for the proportion of points accumulated for correct responses was .34 out of a maximum of 1.00, with individual proportions ranging from .04 to .73. A four-way analysis of variance, Representational Medium (Prints, Slides) x Mode (Color, Black and White) x Sex (Male, Female) x Age (3 Years, 5 Years), was performed, yielding the following results. The effect of age proved significant, F (1, 120) = 21.93, $p < .001$. There were no other significant effects or interactions, although the representational medium x age interaction approached

significance, F (1, 120) = 3.78, $p < .10$. The age effect indicated that the mean proportion of points accumulated for correct responses by 5-year-olds ($\overline{X} = .40$) was significantly higher than that of 3-year-olds. ($\overline{X} = .28$).

In order to permit a comparison between children's verbalized knowledge of photography and their applied understanding of the dual reality of pictures as evidenced in Phase I, correlations were obtained. The relationship between total iconic realism scores and subscores, and photographic knowledge proportions was computed by means of Pearson correlations. A significant negative correlation ($r = -.24$, $p < .01$) was found between total iconic scores and photographic knowledge proportions. Functional and physical property subscores were also significantly and negatively correlated with photographic knowledge ($r = -.22$, $p < .01$ and $r = -.30$, $p < .001$, respectively). Existence subscores and photographic knowledge were not found to be correlated ($r = .00$, $p = .48$). In order to assess how performance on each individual question in Phase III related to the total iconic realism score, the categories pertaining to each question were dichotomized as either correct or incorrect, and a series of point biserial correlations were performed. The results are reported in Table 46. For the majority of items, the correlations between correct responses and total iconic realism scores were negative. Correct responses on questions #5 ("Where do photographs come from?"), #7 ("Let's say you wanted a picture of me, what would you do to get it?"), and #19 (Follow-up justification once the child indicated that a photograph is not the same as a drawing:"If no, how is it

Table 45

Means and Standard Deviations of Proportions of Points Accumulated for Correct Responses to Photographic Knowledge Questions for Representational Medium x Mode x Age x Sex Conditions

Points Accumulated	Rep. Medium		Mode		Age		Sex	
	Prints (n=60)	Slides (n=60)	Color (n=60)	Black & White (n=60)	3 Years (n=60)	5 Years (n=60)	Males (n=54)	Females (n=66)
Mean	.33	.36	.35	.33	.28	.40	.36	.33
SD	.14	.16	.15	.14	.12	.15	.15	.15

Note. The number of points accumulated for correct responses was assigned as a proportion of the total number of possible points. (Maximum = 1.00).

different?") had significant negative relationships to the total iconic realism score. The correlations based on questions #1, 6, 10, 14, 16, and 21 were also negative although these only approached significance, $p < .10$.

In contrast to the abundance of negative relationships, correct responses on questions #18 ("Is a drawing the same as a photograph?") and #20 ("Which is more like a truck, a drawing you made of a truck or a photograph of a truck?") had significant positive correlations with the total iconic realism score.

While thus far the focus has been on correct responses to photographic knowledge questions, in actuality, both correct and incorrect answers shed light on the way in which children view photographs and the photographic process. Some comments will now be made regarding certain qualitative trends observed during the interviews with the children (See Appendix C for the percentages of subjects associated with various response categories).

One tendency, already mentioned in conjunction with earlier phases, was a repeated emphasis by children on pictorial subject matter as opposed to the representational medium. For example, when asked what photographs are made of, whereas 29% of the children responded correctly (i.e., paper, cardboard, film), 20% referred to the content of pictures they had seen (e.g., cat, flower). Similarly, when asked for another word for picture, only 5% of the subjects mentioned "photo," "photograph," or "film," whereas 15% again responded in terms of subject matter. In both instances, 3-year-olds were more likely to offer this form of response than 5-year-olds.

Another pattern that manifested itself throughout the

Table 46

Correlations Between Photographic Knowledge Questions

and Total Iconic Realism Scores

(Page 1 of 2)

Question #	Description	r_{pbi} (N)
1	Do you know another name for picture?	-.14 (120)
2	Have you ever heard of the word "photograph" or "photo"?	-.07 (120)
3	If someone asked you to tell them what a photograph is, what would you tell them?	-.05 (120)
4	What are photographs made of?	-.00 (119)
5	Where do photographs come from?	-.23** (120)
6	What do you have to do to get photographs?	-.14 (108)
7	Let's say you wanted a picture of me, what would you do to get it?	-.25** (120)
8	Have you ever heard of something called a camera? What do you do with a camera?	-.08 (117)
9	Does anyone in your family have a camera?	.00 (120)
10	After we take a picture with a camera, do we have to do anything else to get the picture?	-.14 (117)
11	What do your parents do with pictures after they take them?	.02 (120)
12	Have you ever used a camera?	.07 (118)
13	Why do you think people take pictures?	-.02 (118)

Table 46 (Continued)

Question #	Description	r_{pbi} (N)
14	Besides the pictures we talked about today, have you ever seen any other photographs like this?	-.14 (119)
15	When someone takes a picture of a watch, is the watch in the picture the same as the real watch or is it different?	.07 (119)
16	Follow-up to Ques. 15: How is it different (the same)?	-.12 (111)
17	Do you know what a drawing is? Where do drawings come from?	-.05 (119)
18	Is a drawing the same as a photograph?	.26** (120)
19	Follow-up to Ques. 18: (If no) How is it different?	-.23* (89)
20	Which would look more like a truck, a drawing you made of the truck or a photograph of the truck?	.19* (120)
21	Follow-up to Quest.20: Why?	-.14 (99)

Note. N refers to the number of subjects answering each question. The number of cases varies from question to question due to missing values.

*$p < .05$ **$p < .01$

interviews was a general lack of awareness of the properties associated with specific media and a tendency to confuse drawing and photography. For example, when asked whether a drawing is the same as a photograph, approximately 24% of the children (3 and 5 year-olds combined) indicated that they believed this to be the case. Three-year-olds were more likely to respond this way than 5-year-olds (33% vs. 15%, respectively). Similarly, when asked which would look more like a real truck, whereas 60% of all subjects chose the photograph, 19% believed that a drawing would look more like a real truck. Another 5% equated drawings and photographs in terms of their resemblance to a real truck. In addition, in response to questions probing the origin of photographs, the process was sometimes likened to that of drawing, painting, or writing. Thus, when asked where photographs came from, one child, age 5-9, replied, "People and people color it." With regard to the same question, another 5-year-old commented, "Make one ... well, just get a board and paint it white." Interestingly enough, even children who denied that photographs and drawings are the same sometimes reverted to media confusion in their explanations. Thus, when asked why a drawing and a photograph are not the same, one 5-year-old responded, "Because you use a pen for a photograph and a crayon for coloring." One child's confusion of the two media was not evident until she gave her version of what occurs when photographs are "developed": "We have to go somewhere's special and then they look into the camera and they draw a picture of what's in the camera."

In summary, the final phase of this investigation probed the

general range of information acquired by 3- to 5-year-olds concerning the photographic medium. Analyses indicated that, on the whole, the proportion of points accumulated for correct responses in Phase III was only .34 (maximum = 1.00), indicating substantial gaps in children's knowledge of this pictorial form. Age was the only significant factor, with photographic knowledge proportions significantly higher for 5-year-olds. Photographic knowledge proportions were also significantly and negatively correlated with total iconic realism scores, and both functional and physical property iconic subscores.

Point biserial correlations between each of the photographic knowledge questions and total iconic realism scores revealed that of the 21 questions, three items showed significant negative correlations of correct responses with total iconic realism scores. Interestingly enough, each of these questions required an explanation of the process by which photographs originate, either in and of itself, or in comparison to that of another medium, i.e., drawing. In contrast, the two questions in which correct responses were positively correlated with total iconic realism scores merely required "yes" or "no" responses on the part of the child, or a choice between photograph and drawing. Analysis of patterns of incorrect responses revealed consistent tendencies of children to focus on pictorial subject matter as opposed to the representational medium, and to confuse drawing and photography.

CHAPTER IV : DISCUSSION

Gibson (1971), Hagen (1978) and others (e.g., Haber, 1979, 1980; Kennedy, 1974) propose that photographs (and pictures in general) have a "dual reality" in the sense that while on one level they represent an object, person, or scene, they are simultaneously objects in their own right, with unique textural and spatial features. The same theorists also hypothesize that viewers vary in their sensitivity to pictorial information, particularly that specifying the characteristics of pictures as objects. On this view, while the typical picture-wise adult can attend to information for either the perception of the represented content or for characteristics of the picture itself, children, animals and non-pictorial cultures are presumably far more sensitive to information for the object represented in the picture. Interestingly enough, on an empirical level, researchers have noted that children frequently try to manipulate, scratch, grasp, and "look behind" pictured surfaces (e.g., Church, 1961; Murphy, 1978; Ninio & Bruner, 1976) and these behaviors have also been observed cross-culturally in people presented with photographs for the first time (Deregowski et al., 1972) and in animals (Hayes & Hayes, 1953; Köhler, 1925). It is within this context that the present investigation has attempted to verify the existence of iconic realism, the belief that photographs possess certain properties of their real world referents. In light of the theoretical and empirical framework proposed here, iconic realism is construed as a consequence of the child's attempts to come to grips with the dual reality of pictures, with

the child's lack of awareness of the properties of the picture as an object resulting in a tendency to focus on the properties of the represented content. Thus, theoretical and empirical emphasis has been placed on (1) the effect of varying awareness of the pictorial surface (2) the role of haptic exploration in resolving questions concerning the dual reality of pictures, and (3) the significance of photographic mode (color versus black and white) for picture perception. The discussion will consider these issues as they relate to the findings of the present study.

During the first study phase, children were presented with a set of photographs which varied in their medium of representation, prints or slides, and mode, color or black and white. They were asked a series of questions that probed their tendency to attribute characteristics of real objects to pictures. Total iconic realism scores revealed the significant effects of both age and representational medium. As predicted, the tendency to attribute the properties of real objects to photographs decreased with age, a finding which accords well with the theoretical assumption that children become more sensitive to the properties of pictures as objects in their own right and therefore cope with pictures' dual reality in a more "adult" fashion as they grow older. In contrast, pictorial mode did not significantly influence iconic realism scores. Both color and black and white pictures elicited almost identical amounts of iconic realism, as in the Pearlman and Beilin (1979) study. What these results suggest is that although the color/black and white contrast has captured considerable empirical attention because of

its role in object recognition, this feature does not appear to be important in instances where recognition of objects is not an issue. Rather, as will be seen, it is the properties of the photograph as a representation and varying awareness of the pictorial surface which significantly influence quantitative measures such as iconic realism.

It was also predicted that front-projected slides would be less likely to elicit iconic realism than prints. This hypothesis was predicated on the mechanics of front-projection as a vehicle for separating out the two realities contained within a picture. It was also based on the fact that, in the case of front-projection, the means by which the image is created is more obvious than in back-projection. While the effect of representational medium did prove to be significant as predicted, contrary to what was expected, slides elicited more iconic realism than prints. In order to get a clearer understanding of the dynamics underlying these results, the findings associated with the three question types that served as the basis for the total iconic realism score need to be considered.

As may be recalled, there were three kinds of questions pertaining to iconic realism: functional ("Can you eat this picture of a banana?"), existence ("If you took this crayon and broke it in half, would anything happen to the picture?"), and physical property ("If you touched the picture here, how would the picture feel?"). Each was associated with a unique pattern of results. While analyses of all three question types supported the overall trend for iconic realism to decline as children get older, of the three subscores, the physical property subscore was

the one most significantly influenced by age whereas the functional and existence questions were less so. Physical property questions also elicited significantly more iconic realism than functional and existence questions. What is suggested is that, of the three question types, physical property questions most strongly evoke the conflict between the two realities contained within the picture. Functional questions, which simply required the child to decide whether a picture could fulfill the same function served by the real object, without focusing the child's attention on pictures' dual nature, were least influenced by age, and elicited the least iconic realism. If physical property questions as hypothesized most strongly evoke conflict between the two realities contained within a picture, one would expect this question type to be associated with a high frequency of haptic picture behavior, since manipulation would allow the child the opportunity to obtain information on which to base his response. Physical property questions, in fact, did result in the highest haptic picture scores.

While all three subscores varied significantly with age, only existence iconic subscores were significantly related to the representational medium. The significant representational medium x age interaction indicated that while both age groups were more likely to respond iconically to existence questions when viewing slides as opposed to photographic prints, 3-year-olds in the slide condition had the highest mean existence iconic subscores. The fact that only existence questions were affected by

representational medium suggests that existence questions alone were responsible for the effect of the representational medium seen on total iconic realism scores. To understand what set existence questions apart from other question types, it is necessary to consider findings pertaining to haptic picture behavior and the relationship of this behavior to iconic realism.

As indicated earlier, examination of behaviors elicited in response to questions about iconic realism revealed a wide range of manipulative responses. Given the very general nature of the instructions encouraging children to manipulate pictures, the behaviors bear a surprising similarity to those recorded in the literature. The overwhelming majority of the behavior observed was "appropriate" in the sense that if the child was asked a question referring to a picture, the accompanying behavior was directed towards a picture, rather than to an object and vice versa. "Misplaced" manipulation was a rare occurrence. This finding argues against the notion that iconic realism reflects a blanket confusion between picture and object during the course of the questioning. As will be seen, the "fine-tuning" of children's manipulation of pictures goes even further than these general comments suggest, in that specific categories of haptic picture behavior were found to be linked with certain question types.

Total haptic picture scores and subscores were associated with significant effects for age and sex, and yielded a number of significant interactions. Three-year-olds were more likely to haptically explore pictures than 5-year-olds, and males were more apt to manipulate pictures than females, although these findings were qualified by a three-way interaction which indicated that

picture manipulation varied as a function of representational medium, sex, and age. The only exception to this pattern was the existence haptic subscores. In contrast to the other question types, much less manipulation was elicited by existence questions, and there were no significant effects or interactions. Another interesting difference between existence and the other question types emerges when the relationship between specific categories of haptic picture behavior and question types is examined. Physical property questions were found to be linked to "specific touching" and "smelling" in that 87% and 97%, respectively, of these behaviors were elicited in response to physical property questions. On the other hand, functional questions were specifically associated with "picking out objects" and "blowing" in that 78% and 100%, respectively, of these behaviors occurred in conjunction with functional questions. By contrast, no single behavior category was found to be specifically tied to existence questions. What is suggested here is that children converge on certain behaviors as "appropriate" for ascertaining the information they need to respond to physical property and functional questions. However, in the case of existence questions, there was no "appropriate" manipulation short of actually destroying the picture or the object. Further corroboration for these assumptions is found in correlations computed for the iconic subsample. When relationships between measures of iconic realism and haptic picture behavior were examined, a number of significant negative correlations were found. None of these correlations involved either existence

iconic or existence haptic subscores, which were also unrelated to each other. While these correlations indicated that the incidence of certain forms of haptic picture manipulation was significantly related to a reduction in iconic realism, the fact there was no relationship between existence iconic subscores and any measure of haptic picture behavior suggests that the manipulation that occurred in these instances was not sufficient to alter the occurrence of iconic realism.

The implications of these findings for the role played by the pictorial surface in iconic realism will now be considered. As will be recalled, the contrast between front-projected slides and photographic prints was used as a means of varying awareness of the pictorial surface. While previous research employed back-projected slides on the assumption that they minimize information for the characteristics of the picture as an object, in the present study front-projected slides were used on the assumption that they would be less likely to elicit iconic realism than photographic prints. Front-projection was construed as a vehicle for separating out the two realities contained within a picture. It was also assumed that front-projection would make the means by which the image was created more visible to the child, as opposed to back-projection where, like television, the image "magically" appears on the screen. In view of these assumptions, it is interesting that while the experimenter blocked the light emanating from the projector several times during each pretest, with the result that the image appeared on her hand as opposed to the screen, relatively few children intentionally engaged in the same actions. Of the 60 subjects in the slide condition, only ten

subjects blocked the light within the context of picture-referent questioning. There were also eight instances of this behavior outside the context of picture-referent questioning (i.e., either before or after the experimenter asked the questions). Only two subjects commented on the observed separation of image and screen. In view of the emphasis in the literature on the role of the child's own actions in learning to resolve the dual nature of pictures, it is not clear what value, if any, simply observing the experimenter block the light could be to the child. In addition, the experimenter also noticed that 3-year-olds did not generally turn around to look at the projector. Taken as a whole, it appears that within the context of the present investigation, front-projected transparencies were functionally equivalent to back-projected transparencies with the result that information for pictures as objects was reduced, and front-projected slides elicited significantly more iconic realism than photographic prints. In view of what was said earlier about haptic picture behavior, the fact that the effect of representational medium was seen only in conjunction with existence questions appears to relate to the low incidence of manipulation associated with this question type. Given the small amount of manipulation that occurred in response to existence questions, children were unable to counteract the fact that less information for pictures as objects was provided by slides than prints. The finding that 3-year-olds in the slide condition had the highest existence iconic subscores is in accord with these assumptions, since these subjects are probably less sensitive to the properties of

pictures as objects than their 5-year-old counterparts. As will be seen, this interpretation of the results was also supported by the findings from the counter-iconic challenges.

This discussion of haptic picture behavior will conclude by considering the possibility that these behaviors are an artifact of instructions given prior to administration of the task. It may be recalled that, by way of introducing the task of picture-referent questioning, children were told that they could "touch the pictures, turn the pictures over, or look behind the pictures." These instructions gave children the freedom to manipulate pictures if desired, and were included because pilot work indicated that children sometimes expressed a desire to touch the pictures yet were reluctant to handle the experimenter's materials. Although it might be maintained that the resulting haptic behaviors were artifactual, the findings argue against this interpretation. Firstly, while the instructions were rather general in nature, 12 very different haptic behaviors were observed, behaviors which bear a surprising similiarity to those reported in the literature (see Church, 1961; Hayes & Hayes, 1953; Köhler, 1925; Ninio & Bruner, 1976). Children "touched" pictures in a variety of ways, from placing a single finger on a specific spot on a picture, scratching or running one's fingers across the surface of a picture, to using a "pincer" motion to pick an object out of a picture. In addition, children exhibited behaviors particular to certain objects such as smelling the pictures of the rose and the banana, shaking the picture of the rattle, or listening to the picture of the watch, although these behaviors were never specified in the

instructions. Finally, the use of the instructions cannot explain why certain question types elicited more haptic behavior than others, or why certain haptic behaviors were found to be linked to certain question types (e.g., specific touching and physical property questions).

The findings associated with confirmatory and disconfirmatory behavior further substantiate that the haptic behavior observed was not merely "elicited" but served a definite purpose, providing the child with "evidence" in favor of either modifying or maintaining his original belief. Four types of confirmatory/disconfirmatory behavior were displayed: positive confirmation, negative confirmation, positive disconfirmation, and negative disconfirmation. In all, 47% of haptic picture behavior was categorizable in these terms, the remainder unclassifiable because the child either manipulated the picture prior to making a prediction or simply made no comment following manipulation. This is a surprisingly high percentage, considering the fact that children's comments about the outcome of their haptic exploration were completely spontaneous and unsolicited. The two most frequently occurring forms of these behaviors, negative confirmation and negative disconfirmation, were both associated with significant, although opposite, effects for age. These findings illuminate the way in which the two age groups approach the paradox posed by the dual reality of pictures. Five-year-olds were more likely to engage in negative confirmation. Thus, although 5-year-olds, in these instances, had already responded non-iconically, conflict created by the

experimenter's questions was resolved by reaffirming the characteristics of pictures as objects in their own right. Of the 50% of 5-year-olds' haptic picture behavior that was categorizable as confirmatory/disconfirmatory behavior, 34% was devoted to the reaffirmation of non-iconic responses. In contrast, for 3-year-olds, of the 43% of their haptic picture behavior that was categorizable in these terms, responding was equally divided between negative confirmation (mean proportion = .17) and negative disconfirmation (mean proportion = .16). Three-year-olds were found to be more likely to engage in negative disconfirmation than 5-year-olds. Thus, in addition to the reaffirmation of the child's original response, for 3-year-olds, manipulation also served a corrective function in that it provided a source of contradictory input which the child used to modify his original response. Thus, 3-year olds' iconic realism scores would have been higher were it not for the role played by manipulation.

During Phase I, children were also presented with a parallel set of questions regarding the pictures' real world referents. This provided a measure of children's familiarity with the properties and functions normally associated with these objects, and enabled a comparison between iconic realism and children's referent knowledge. As would be expected, children's knowledge of real objects, as reflected by total referent scores, was almost perfect, although 5-year-olds achieved somewhat higher scores than 3-year-olds, and girls performed at a slightly higher level than boys. These general effects were qualified by a significant sex x age interaction, indicating that the total referent scores

increased with age for males, but not for females, and that sex differences appeared only at the 3-year-old level. Of the subscores, functional scores (sample mean = 5.94) deviated least from the maximum score of 6, and were not associated with any significant effects or interactions. Physical property subscores (sample mean = 5.70) were somewhat lower and showed the same pattern seen in conjunction with total referent scores. Thus, although referent knowledge is generally complete even at 3 years of age, children are slightly more familiar with the functions of real objects than they are with their physical properties.

In respect to the relationship between iconic realism and referent knowledge, one unexpected finding was the significant low negative correlation between functional iconic and functional referent subscores. This was surprising in view of the fact that there was very little variability on either of these measures. The majority of subjects received perfect functional referent scores of 6 and functional iconic scores of 0. Analysis of the performance of individual subjects revealed that the negative correlation was actually based on seven subjects who had functional referent subscores of 5. Functional iconic subscores for the same subjects revealed that the majority had functional iconic subscores of one or more. The negative correlation between these two variables was even stronger when iconic subjects alone were considered, as four out of the five subjects with functional referent scores of 5 had iconic realism scores of one or more. These findings also explain the significant, although not as strong, negative correlation between total referent and

functional iconic scores.

In addition to these negative correlations, when iconic subjects alone were considered, several low positive correlations emerged between the following measures of iconic realism and referent knowledge: physical property iconic and physical property referent subscores, physical property iconic and total referent scores, total iconic and physical property referent scores, and existence iconic and total referent scores. What these data suggest is that to a small extent the attribution of certain characteristics of real objects to pictures is a function of having related knowledge about the referents themselves.

In addition to the quantitative data already described, qualitative data were obtained during Phase I in the form of children's justifications for their responses. One intriguing hypothesis verified during Phase I was the tendency of children to engage in iconic realism. The justifications which children provide for these responses support this hypothesis. Of the five categories of iconic justifications, content-related justifications (mean proportion = .41), were most frequent. Thus, when asked, why a photograph of an ice cream cone would feel cold, children commonly responded, "Because ice cream's always cold," or "Because it was in the freezer." The significant realism x age interaction in respect to iconic justifications indicated that while 3-year-olds provided the same proportion of content-related justifications regardless of the mode of the pictorial stimuli, 5-year-olds were more discriminative in that they tended to reserve their content-related justifications for color pictures. Correspondingly, the

significant mode x sex interaction associated with content-related justifications revealed that the two sexes discriminated on the basis of the mode of the pictorial stimuli, although this discrimination took different forms. The important fact underlying these findings is that in providing content-related justifications, children were actually verbalizing an emphasis on the represented objects as opposed to the medium of representation (i.e., the picture), which in essence, is what the phenomenon of iconic realism is about.

In children's justifications for their non-iconic responses, representational justifications (e.g., you can't eat a photograph of a banana "because it's not real, and you'll get sick if you eat this picture") were the most popular. Representational justifications were more likely to be given by 5-year-olds than by 3-year-olds, paralleling the tendency for iconic realism to decline with age. These results also suggest that the ability of children to think along a dimension of "real-pretend" increases as they grow older.

Lastly, for explanations associated with referent attributions, content-related (mean proportion = .40) and real justifications (mean proportion = .38) were most frequently used. In content-related referent justifications, the child described some property or action normally associated with an object (e.g., the flame on a candle would feel hot "because you light it with matches" or "because it would burn you all up" or simply "because it's fire"). In contrast, in real justifications, the child attributed certain properties or functions to a referent because

he characterized the referent as being real rather than a representation of reality. Thus, one could bounce the referent ball "because that one's real (the referent) ... and that one's make-believe (the picture)." Both justification types were associated with significant, although opposite effects, for age and sex. Thus, while 3-year-olds were more likely to provide content-related justifications than 5-year-olds, 5-year-olds were more likely than 3-year-olds to provide real justifications for their referent attributions. Whereas males were more likely than females to offer content-related justifications, females were more likely than males to offer real justifications for their referent responses. The findings for referent justifications thus echo the pattern of results obtained with respect to referent attributions where age and sex were also significant factors.

There is some indication that some types of justification may be more sophisticated than others. Content-related justifications appear to be less sophisticated than real justifications as emphasis in the former is on properties and actions associated with one form (referent) whereas in the latter, the explanation entails an implied, if not explicit, juxtaposition of both picture and object. These assumptions find support in data that show that subsamples that were more likely to provide content-related justifications had significantly lower total referent scores than subgroups who were more likely to offer real justifications and had higher total referent scores.

This discussion of Phase I will conclude by considering the possibility that a response bias, rather than genuine belief that photographs share the properties of real objects, produced the

finding of iconic realism. That is, since picture questions were generally phrased so that an affirmative response indicated belief in iconic realism, the possibility exists that children may have responded to certain "demand characteristics" of the situation by answering "yes" to these questions. In view of this, it is important to consider the findings associated with four physical property questions (ice cream cone, candle, banana, rose). These physical property questions consisted of non-suggestive, open-ended probes (e.g., "If you touched the picture here, how would the picture feel?") followed by more specific probes ("Would the picture feel cold?") requiring a yes or no response. In cases where the child spontaneously attributed the property of the real object to the photograph (e.g., "cold") in response to the initial probe, the more directed probe was omitted. Differentiation of iconic responses into those which represented spontaneous attributions as opposed to affirmative answers revealed that, as a whole, 44% of the iconic responses to these four questions were spontaneous attributions. For example, of those who maintained that the photograph of the fire on the candle would feel hot, 69% were spontaneous attributions. This is particularly strong evidence in light of the fact that these four physical property questions alone, out of a total of eighteen questions, accounted for 60% of all iconic realism. In addition, the notion that iconic realism reflects the operation of a response bias does little to explain the pattern of results already described. Given such a response bias, one would expect to have observed more iconic realism (the overall mean was only

2.34 out of a possible 18). Such a bias also does not explain the significant effect of representational medium, nor can it account for the difference in the amount of iconic realism occurring in response to functional, existence, and physical property questions. Finally, it does not explain the difference in affirmative responding to referent questions (overall mean = 11.64 out of a possible 12) and picture questions (overall mean = 2.34 out of a possible 18).

Phase II was a systematic attempt to explore the relationship between haptic manipulation and pictorial understanding. Only those subjects who exhibited iconic realism during Phase I participated in this phase. Counter-iconic challenges were structured in terms of the original three question types, with the addition of the "expected" category for existence questions. The latter entailed the performance of an action on either the picture or the referent, and anticipating the consequences for its counterpart. Analysis of "residual" iconic realism revealed that substantial iconic realism remained despite exposure to physical evidence contrary to this belief. The counter-iconic challenges reduced the tendency to engage in iconic realism in a fashion consistent with performance on Phase I. While a limited amount of iconic realism was elicited in response to functional questions during Phase I, no residual functional iconic realism remained following the counter-iconic challenges. Thus, when actually confronted with using a picture to fulfill the function of its real world referent, children deny, for example, that they can write with a picture of a crayon or bounce a picture of a ball. In contrast, a substantial amount

of iconic realism remained following the physical property challenges (37%), consistent with the fact that this question type was associated with the highest iconic realism scores during Phase I. Again, these findings are consistent with the assumption that it was the physical property questions which most strongly evoked the conflict generated by the dual reality of pictures and that these were beliefs children were most reluctant to relinquish.

Existence questions, which elicited an intermediate amount of iconic realism during Phase I, maintained their relative position following the "actual" portion of the existence challenge (i.e., where the child actually witnessed the consequences of an earlier action on either a picture or an object for its counterpart). The comparison between the outcome of the "expected" and "actual" portions of the existence challenge provides support for earlier speculation concerning the relationship between haptic picture manipulation and the tendency to engage in iconic realism. When children performed an action on either the picture or object, and simply anticipated what would happen to its counterpart, it was found that photographic slides yielded significantly more residual iconic realism than photographic prints. As a whole, 53% of the iconic realism elicited in response to existence questions during Phase I remained following the "expected" portion of the existence challenge. However, once the consequences of their actions were observed, only 6% of the iconic realism originally elicited in response to existence questions remained, and representational

medium no longer had a differential effect. These findings therefore lend support to the conclusion that the significant effect for representational medium associated with existence questions (Phase I) stemmed from the lack of appropriate manipulation. It suggests that, in the course of engaging in manipulation appropriate to existence questions and observing its consequences, children gain information about pictures as objects, causing the difference between the two representational media to disappear. It should also be recalled that each counter-iconic challenge was not an isolated occurrence but part of a sequence of challenges. Thus, for example, the fact that only 53% of the iconic realism originally elicited during Phase I remained following the "expected" portion of the existence challenge reflects the fact that some subjects experienced earlier existence challenges and may have responded non-iconically to all portions of existence challenges that followed. During Phase I, children were somewhat more apt to believe that performing an action on a referent affected a picture (type 1) than performing an action on a picture altered an object (type 2). This tendency remained consistent during Phase II in that more iconic realism was elicited by type 1 questions for both portions of the existence challenge.

Finally, examination of justifications elicited during Phase II revealed that content-related and representational categories were again the most popular forms of explanation for iconic and non-iconic responses, respectively. "Quasi" responses may represent a transitional form between iconic and non-iconic responses. These responses were elicited in response to physical

property challenges, and signified the belief that the picture possessed a property (e.g., coldness) normally attributed to an object, but not to the same extent as the real world referent. Consistent with this, quasi responses were only associated with the representational, no justification, and ambiguous/ idiosyncratic categories of explanation.

One unexpected finding was the appearance of consistent sex differences in the first two phases of the study. Sex differences were found for both response measures (haptic and referent scores) and justifications in Phase I and for justifications in Phase II. Throughout Phase I, males consistently engaged in more haptic exploration of photographs than females, with significant main effects for sex on almost every haptic score. Only in the case of existence haptic subscores was there no main effect for sex, although here again the effect approached significance in the favor of males. A number of interactions illustrate the way in which this tendency varied with age and representational medium. For example, for functional haptic scores, the sex x age interaction indicated that the main effect for sex associated with these scores was actually based solely on the differential between 5-year-old males and females. A number of haptic measures were associated with significant representational medium x sex x age interactions, with males maintaining their haptic "superiority" over females in almost every cell. Males also maintained a larger differential in the haptic behavior directed toward the two representational media, although the direction of this difference varied with age. In general, 3-year-old males

manipulated prints more than slides, with the reverse for 5-year-old males. The underlying basis for male haptic "superiority" (e.g., males are simply more active than females at this age, feel more comfortable in the experimental situation, or are more inquisitive about pictures as objects) is a question for future investigation.

Referent scores were also subject to sex differences, with females achieving substantially higher scores than males on both total and physical property referent scores. Sex x age interactions associated with these measures indicated that while males' scores increased with age, females' knowledge of real objects was virtually complete by 3 years of age. Females' superior understanding of real objects is further indicated by their use of the more "sophisticated" real justifications for referent attributions as opposed to the content-related justifications used most frequently by males. The response pattern exhibited by females thus resembles that of 5-year olds.

The remaining sex differences for justifications will be discussed in conjunction with the effect of pictorial mode. The only significant effects associated with pictorial mode were for children's justifications. In these instances, pictorial mode rarely occurred as a main effect, figuring largely in two- and three-way interactions with age and sex. The most consistent trend, already mentioned with respect to referent justifications, was for the justification pattern of female subjects to resemble that of 5-year-olds. For example, in Phase I, for the most common form of iconic justification, content-related explanations, sex and age each independently interacted with pictorial mode. The

significant mode x age interaction indicated that while 3-year-olds provided the same proportion of content-related justifications regardless of mode, 5-year-olds tended to reserve content-related justifications for color pictures. Correspondingly, the mode x sex interaction indicated that females, like 5-year-olds, provided more content-related justifications for color than black and white pictures. The same pattern was also observed with respect to the second most frequently used iconic explanation in Phase I, "no justification." Here the mode x age interaction indicated that 5-year-olds were more apt to offer no justification for black and white pictures than color, with the reverse for 3-year-olds. Again, the mode x sex interaction associated with this justification category indicated a response pattern for females resembling that of 5-year-olds, and one for males similar to 3-year-olds. Thus, in general, the justifications chosen by females and the way in which these justifications are applied appears to be more "mature" than that shown by males in that the former follows the pattern set by older subjects.

Having established how children react to information contrary to their belief in iconic realism, we now consider performance on the final segment of the study, which probed children's familiarity and experience with the photographic medium. All subjects participated in Phase III, which consisted of a series of questions ranging from basic terminology and mechanics to more abstract considerations, such as media differences. Points were credited for correct answers, with the

number of points awarded varying as a function of the complexity of the child's response. Despite the ubiquity of photographs in daily life, the proportion of points accumulated for correct responses was only .34 (possible maximum = 1.00), indicating substantial gaps in children's knowledge. As one would expect, age proved to be a significant factor, with the proportion of points accumulated for correct responses being substantially higher for 5-year-olds. While these findings focus on correct responses, in actuality, both correct and incorrect responses should be considered in understanding how children view photographs and the photographic process. The discussion will now touch upon several response trends observed during the interviews with the children.

One tendency, already discussed in conjunction with earlier phases, was the repeated emphasis by children on pictorial subject matter as opposed to the representational medium. For example, when asked what photographs are made of, children often referred to the content of pictures they had seen (e.g., cat, flower). Similarly, when asked for another word for picture, only a small proportion of the subjects mentioned "photo," "photograph," or "film," children more commonly responding in terms of subject matter. In both instances, 3-year-olds were more likely to offer this form of response than 5-year-olds. This focus on represented subject matter is consistent with Gibson's (1971) notion of the naive attitude, and Gardner's work on children's conceptions of the arts (Gardner, Winner, & Kircher, 1975). Gardner et al. asked children of different ages to identify various works of art, and discovered that children in

the 4- to 7-year-old range tended to center on the content, ignoring the medium in which the work was depicted. Thus, in accordance with the findings of the present study, a painting of a horse was identified as merely "a horse." In contrast, older subjects responded equally to both the content and the medium, or focused exclusively on the medium. Gardner et al. also noted that their youngest subjects were generally insensitive to stylistic features, which again are properties of the medium. Thus, for 4- to 7-year-olds, "the medium was but a transparency through which representations of the world might be glimpsed" (Gardner et al., 1975, p. 69).

A recent study by Seidman and Beilin (1984), concerned with cross-media effects on picturing, obtained similar results. Preschoolers, school-age children, and adults were asked to comment aloud as they produced either photographs or drawings. The youngest group made more references to content than older subjects across media, although the difference between the groups was greater for the photographic task. With respect to the latter, the results are interpreted as evidence for "a progression with age from viewing photography as only reflecting the real object (preschoolers) to viewing it as a medium that allows for control and alteration of reality (school-age children and adults)" (Seidman & Beilin, 1984, p. 667).

Gardner et al. (1975) also questioned children regarding the origin of works of art, with surprising results. For example, when asked to indicate where paintings come from, few children spontaneously acknowledged that people create paintings. Instead,

the children displayed a general lack of interest in the creator of the work, dwelling instead on particular locations where photographs might be seen, such as the store or school. Interestingly enough, although after extended probing the majority of children finally admitted that works of art are ultimately human creations, Gardner et al. found that some subjects lacked "even an implicit knowledge of a human source" (1975, p. 66). While the present study uncovered a close tie between the photograph and its referent, again the link between process (use of a camera) and product (photograph) was not necessarily evident. When asked where photographs come from, only 17% of the children (3- and 5-year-olds combined) spontaneously made reference to the use of a camera. Here, too, children focused heavily on particular locations such as the store, school, or the post office. While the majority eventually agreed that cameras ultimately produce photographs, a small number remained uncertain as to how photographs originate.

In line with Gardner et al.'s report that young children are generally unaware of the properties associated with specific media, and may believe, for example, that a photograph and a painting are the same thing, the present study found that children demonstrated the same kind of confusion with respect to photography and drawing. This confusion manifested itself throughout the interviews with the children. For example, when asked whether a drawing is the same as a photograph, children often indicated that they believed this to be so. Similarly, when asked which would look more like a real truck, some subjects believed that a drawing would look more like the real truck while

others equated drawings and photographs in terms of their resemblance to a real truck. In addition, in response to questions probing the origin of photographs, the process was sometimes likened to that of drawing, painting, or writing.

Having established how children conceive of photographs and the photographic process, we will now consider how this knowledge relates to the tendency to engage in iconic realism. Correct response scores on Phase III were found to have significant low negative correlations with both total and functional iconic realism scores, and a significant moderate negative correlation with physical property iconic realism scores. Thus, iconic realism appears to be weakly related to lack of knowledge about the photographic medium, with this correlation being largely a function of the stronger relationship between photographic knowledge and the tendency to engage in iconic realism in response to physical property questions. Point biserial correlations between each photographic knowledge question and total iconic realism scores further revealed that correct responses on three items had significant negative correlations with total iconic realism scores. Two of the questions were part of the series probing children's conceptions of how photographs originate, while the third required the child to explain how a drawing is different from a photograph. All three items thus shared an underlying similarity in that they required an explanation of the process by which photographs originate, either in and of itself, or in comparison to that involved in drawing. Based on what has already been said regarding the relationship

between physical property iconic realism and photographic knowledge, these findings imply that children's lack of awareness of the process by which photographs originate is linked to their confusion about the physical properties captured by photography as a medium.

This discussion will conclude with the implications of the present study for future research on this topic. Given the finding that children engage in iconic realism in response to photographic prints and slides, one intriguing issue is whether this phenomenon is media-specific or whether it also occurs in response to other modes of representation. One obvious candidate for investigation is drawing, for which at least one report of iconic realism exists (i.e., Muchow cited in Werner & Kaplan, 1963). In the present study some children were confused about the properties specific to drawing and photography. While variation in color and size has not been found to affect iconic realism, a contrast between photographs and line drawings, which capture less representational detail, might illuminate the role played by realism in this phenomenon. Also, since characteristics of the pictorial surface have been found to influence iconic realism in response to the photographic medium, it would be interesting to find out if this also holds true with regard to other representational media.

Another question worthy of consideration is the extent to which the changes brought about by the counter-iconic challenges remain stable over time. Only 30% of the iconic realism elicited during Phase I remained after the challenges. It would have been interesting to test children at a given time interval after these

challenges to see if these effects were long-lasting or whether they simply reflected a short term effect.

On a broader scale, one can ask how the tendency to attribute the properties of real objects to photographs "fits in" with the way in which 3- to 5-year-olds are typically characterized by developmentalists. Recent work by Flavell and his associates (See Flavell, 1986) suggests that iconic realism may be an expression of a more general distinction between appearance and reality. In studies reported by Flavell, children were presented with situations where, for example, a white stimulus, such as a glass of milk, was temporarily made to appear blue by being moved behind a blue filter. The children's task was to indicate how the stimulus appears to their senses (i.e., "What color does it look like to your eyes right now?") as opposed to the true nature of the stimulus (i.e., "What color is it really and truly?"). Flavell reports that while 3-year-olds have little or no understanding of this distinction, by 5 or 6 years of age, children perform relatively well on these tasks, although they still experience difficulty when asked to reflect upon the appearance/reality distinction. Interestingly enough, in tasks which required the child to distinguish between real and apparent properties of objects, as in the milk example, phenomenism errors predominated. That is, in these instances, "appearance" answers are given to both questions. These findings are reminiscent of the present study where of all three question types, questions relating to physical properties were most likely to elicit iconic realism, causing the child to focus on appearance (properties

associated with content) as opposed to reality (properties associated with the picture itself). In addition, Flavell believes that a dual reality conflict, like that hypothesized as responsible for iconic realism, underlies children's difficulty with the appearance/reality distinction:

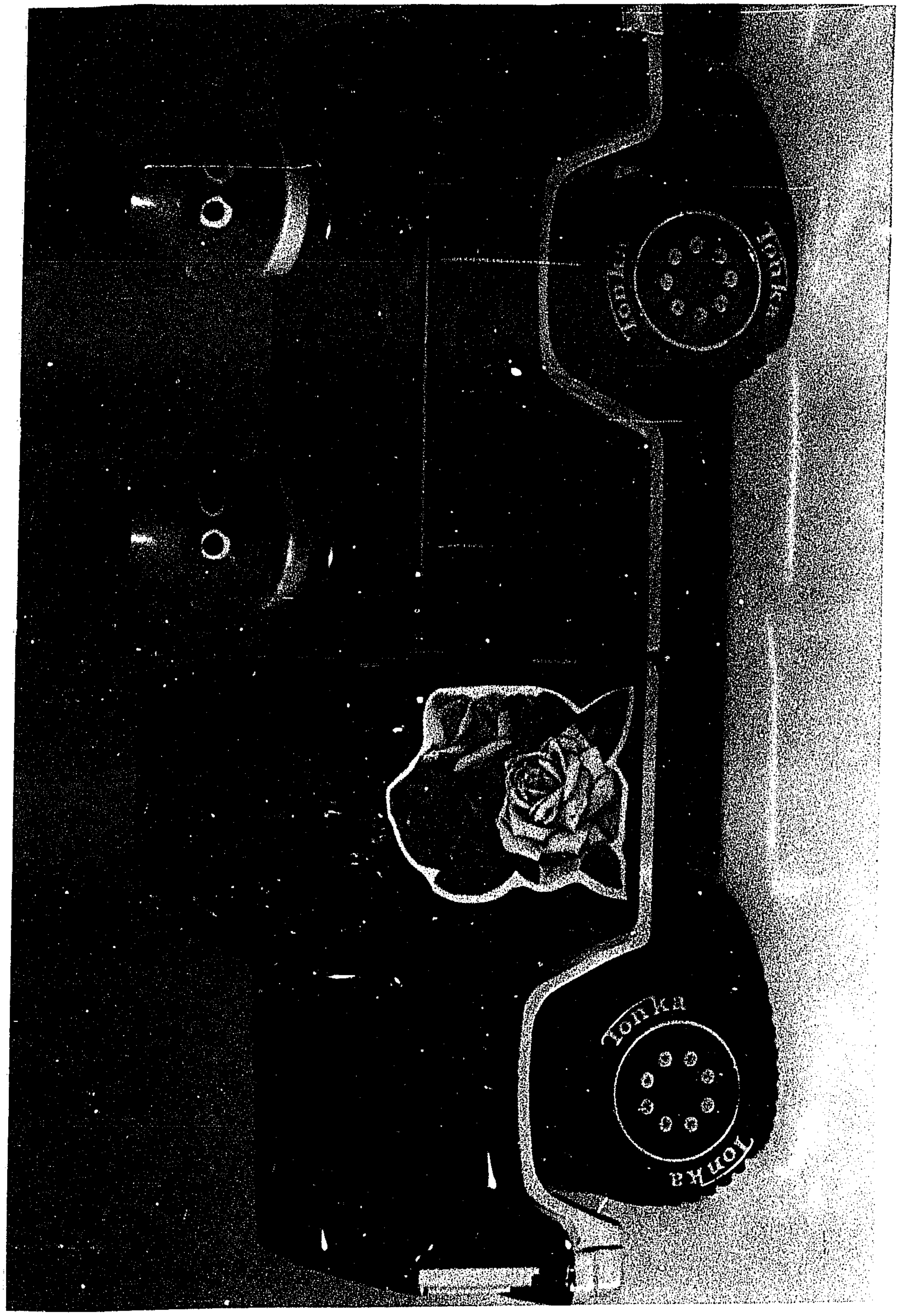
> To solve these tasks we have to attribute such mutually incompatible and contradictory properties and identities to the same object at the same moment in time. As adults, we easily resolve the seeming contradiction by identifying one representation of its property or identity with its present appearance and the other with its reality .... Although we are aware that external objects themselves cannot simultaneously be two different things at once, we are also aware that we can represent them as simultaneously looking like the one thing ("that's what it looks like") and really being the other ("that's what it really is") .... Young children are less cognizant of these facts about subjectivity and mental representation than older children and adults are .... Instead, they may try only to decide what single thing the object "is" ... (Flavell, 1986, p. 422)

Flavell believes that other abilities such as perspective-taking and symbolic play are also developmentally related to the appearance/reality distinction and are founded on a similar form of "dual representation."

In conclusion, the findings of this study have ramifications not only for the use of photographs as empirical surrogates for real objects, but also for the body of theory concerned with picture perception. Many of these theories (e.g., Gibson, 1971, Goodman, 1968) are modeled on the adult perceiver, and supply sketchy, if not contradictory, details about the course of development culminating in adult status. Of these approaches, Goodman's (1968) conventionalist view seems least able to accomodate the present findings. For one thing, Goodman explicitly denies the possibility that a viewer might erroneously

attribute the properties of real objects to pictures. In addition, while Goodman distinguishes between the two realities contained within a picture, unlike Gibson and others, he does not claim differential sensitivity to this information on the part of certain viewers. As may be recalled, it is this lack of awareness of the properties of pictures as objects which appears to provide the foundation for iconic realism, and to account for the observed difference between photographic prints and slides. In view of these observations, the findings of the present study should be looked upon both as evidence that a more developmental approach to picture perception is needed (i.e., Beilin, 1983), and as providing a missing piece of the developmental "picture."

APPENDIX A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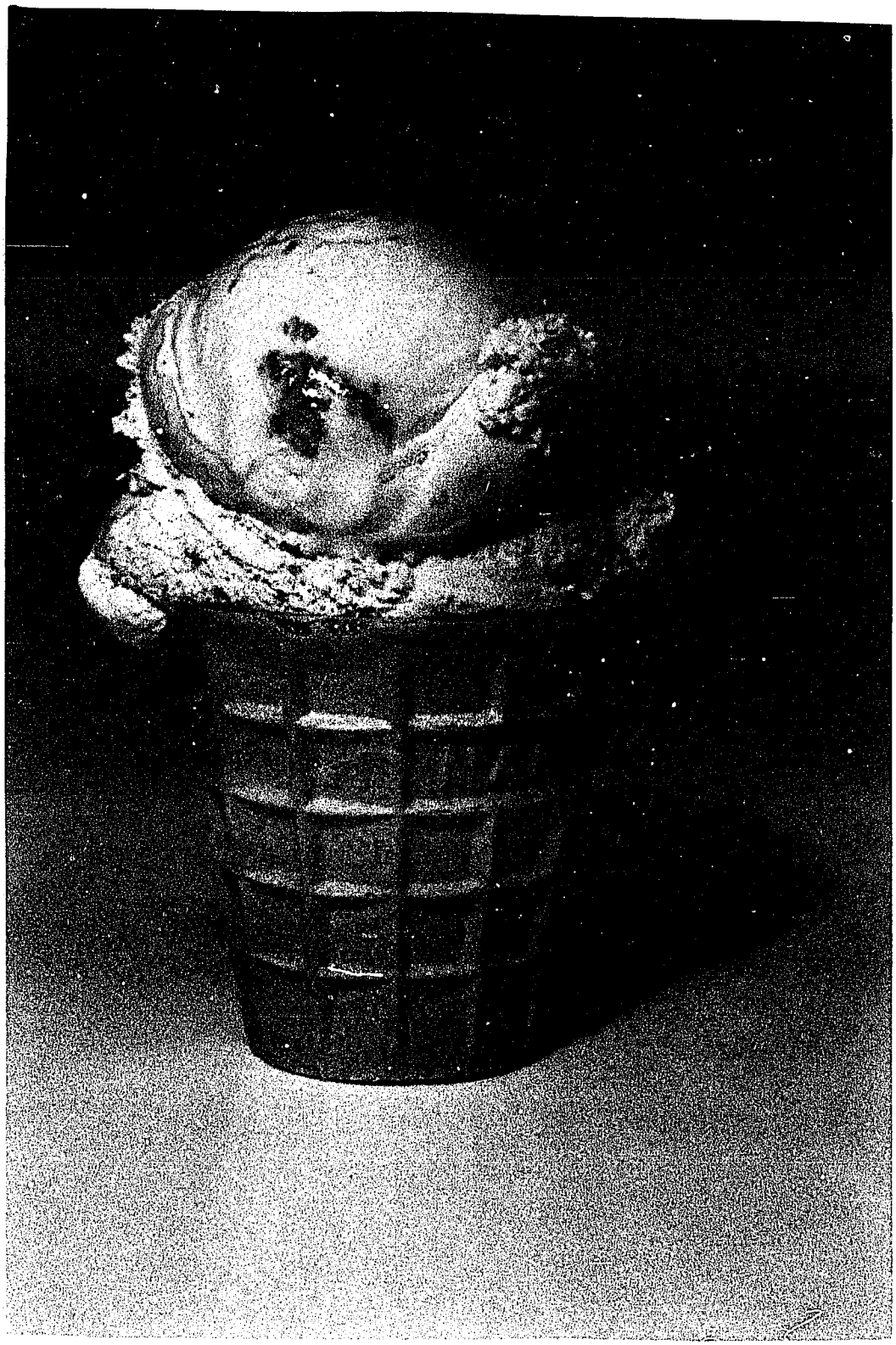

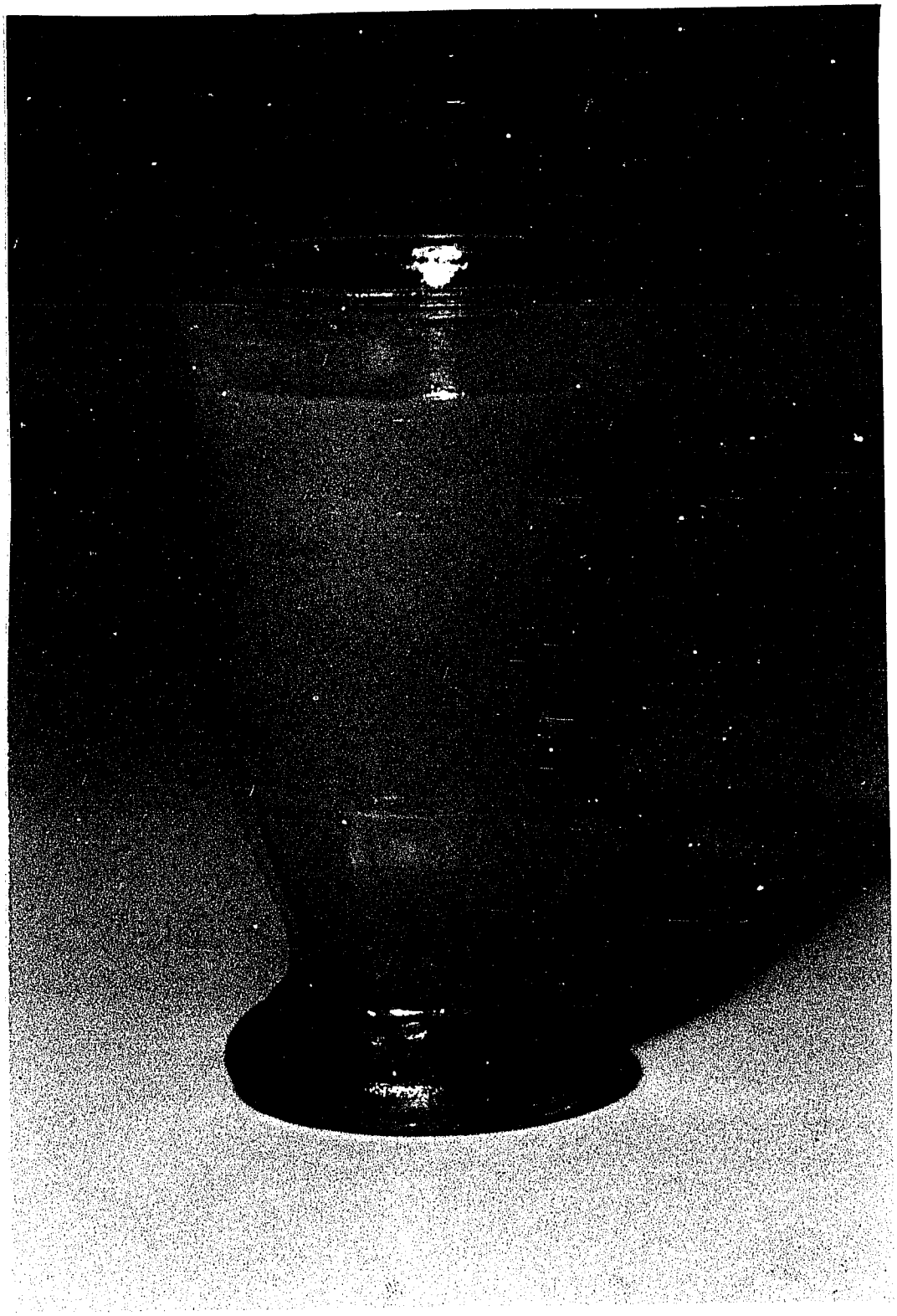

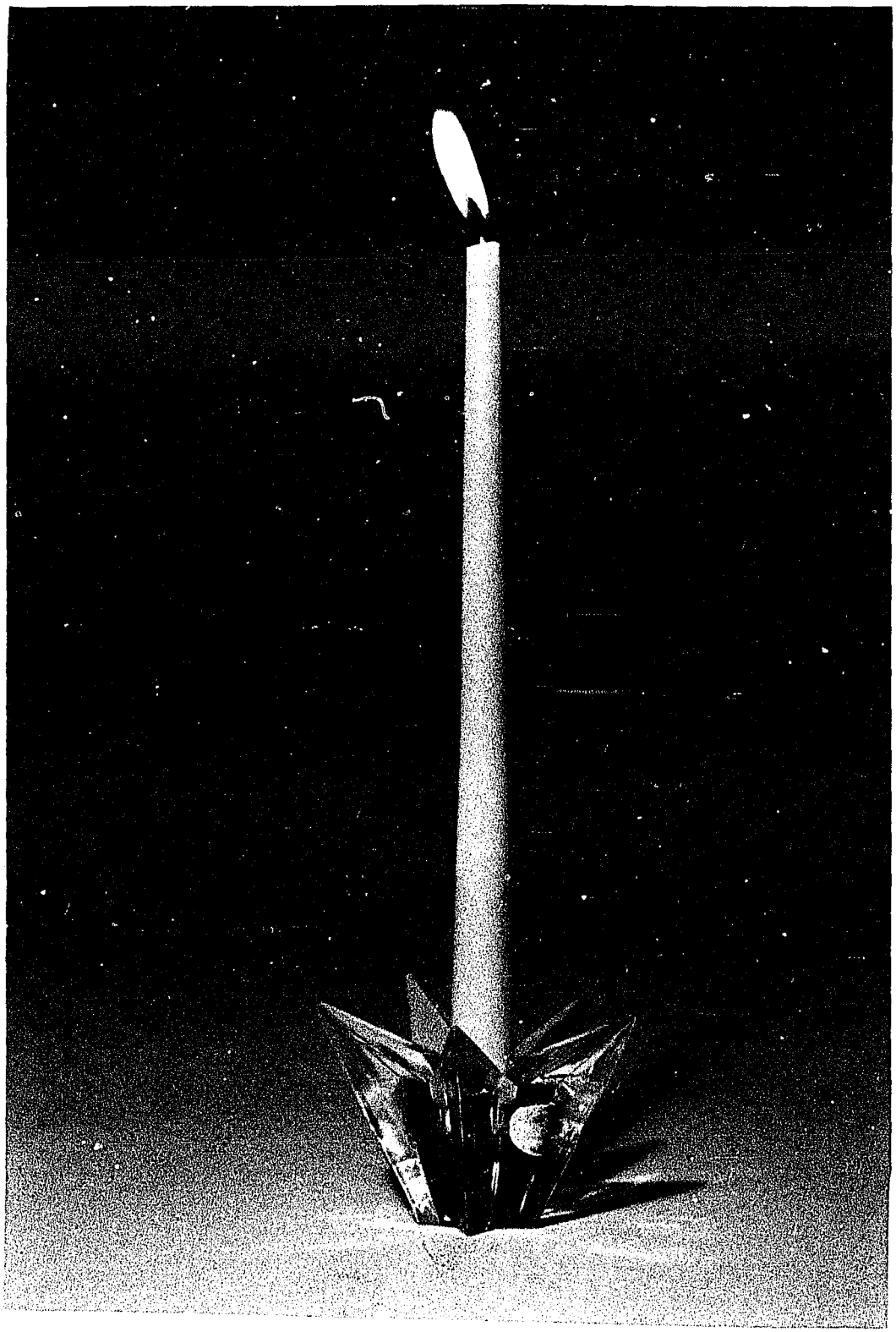

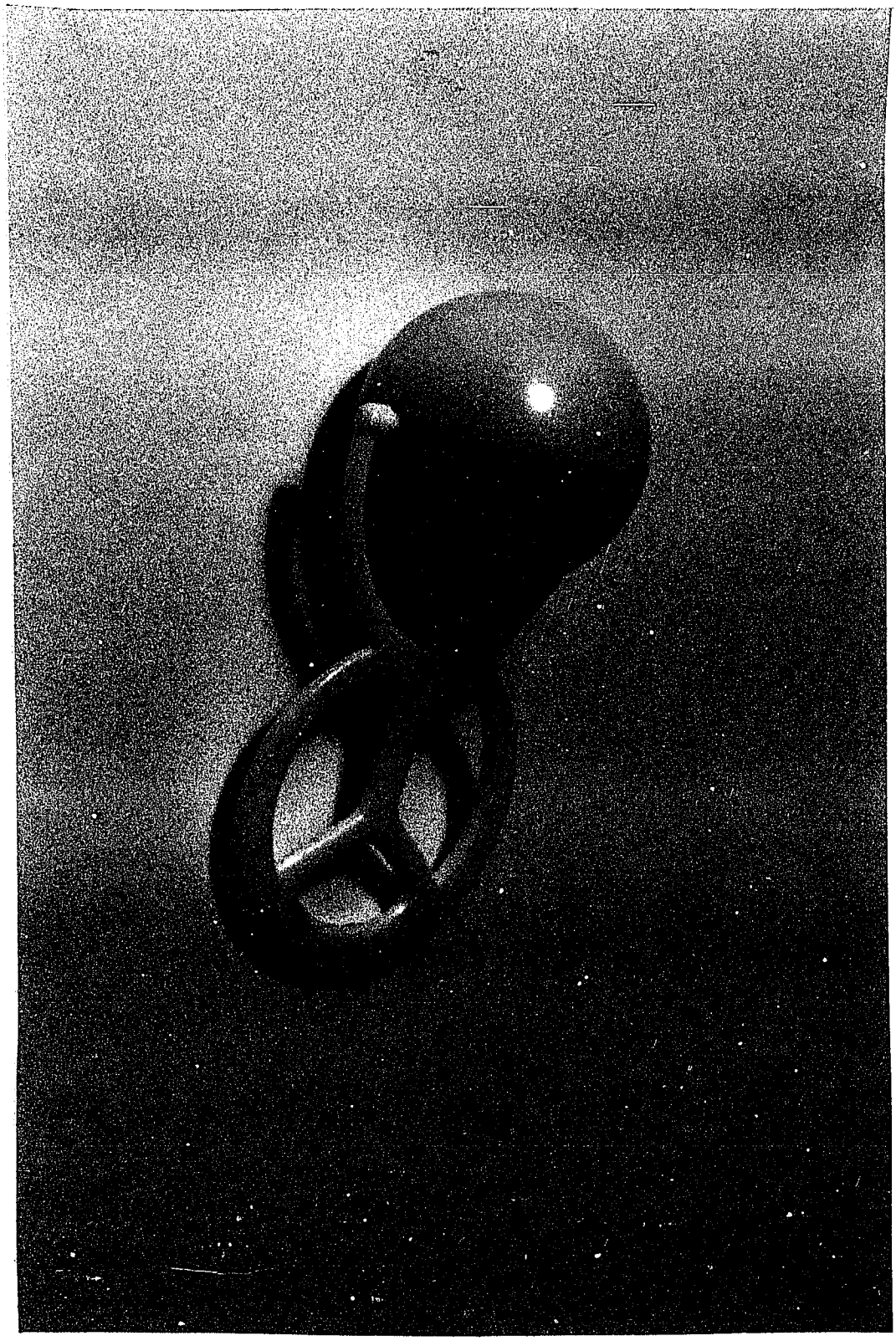

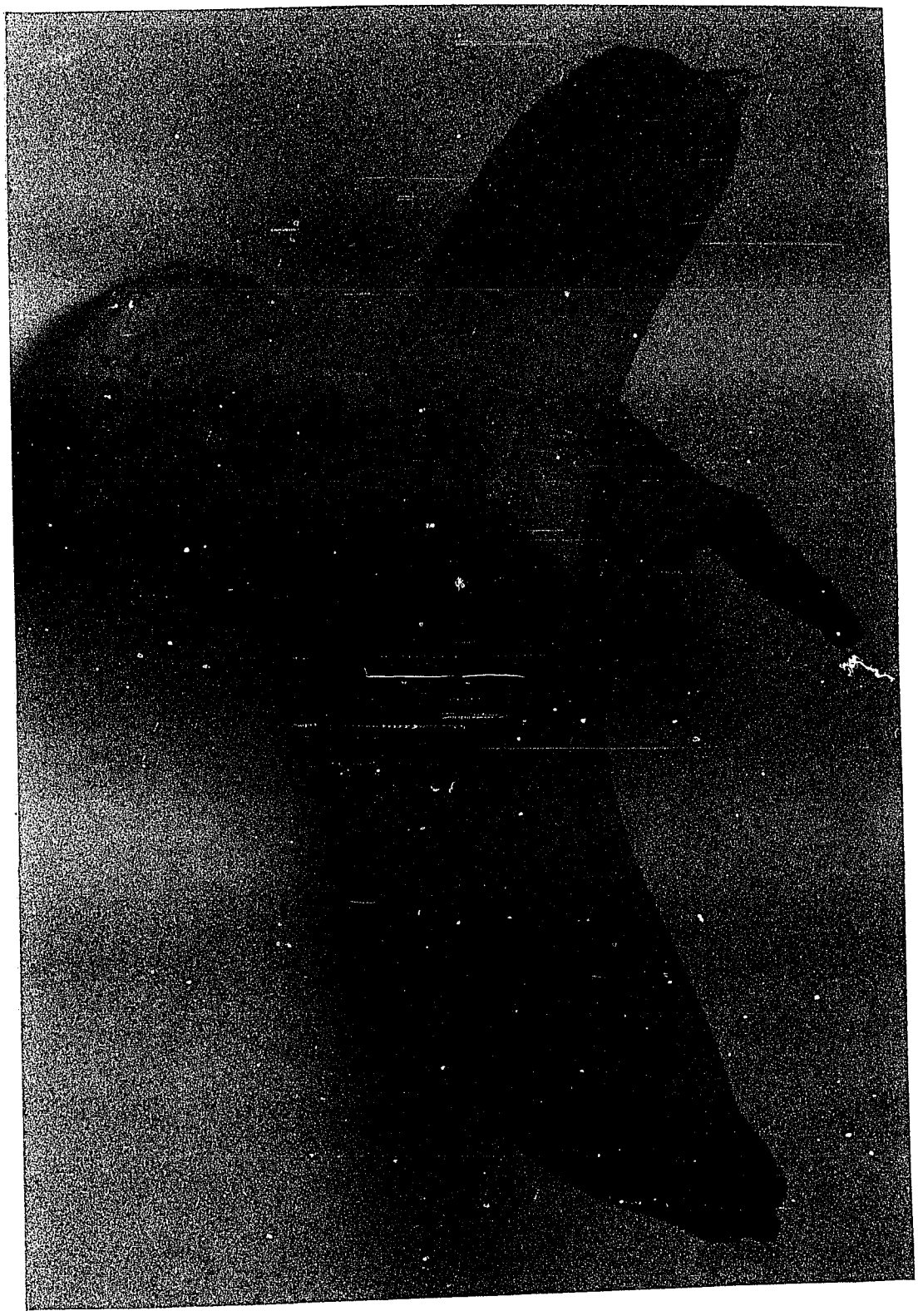

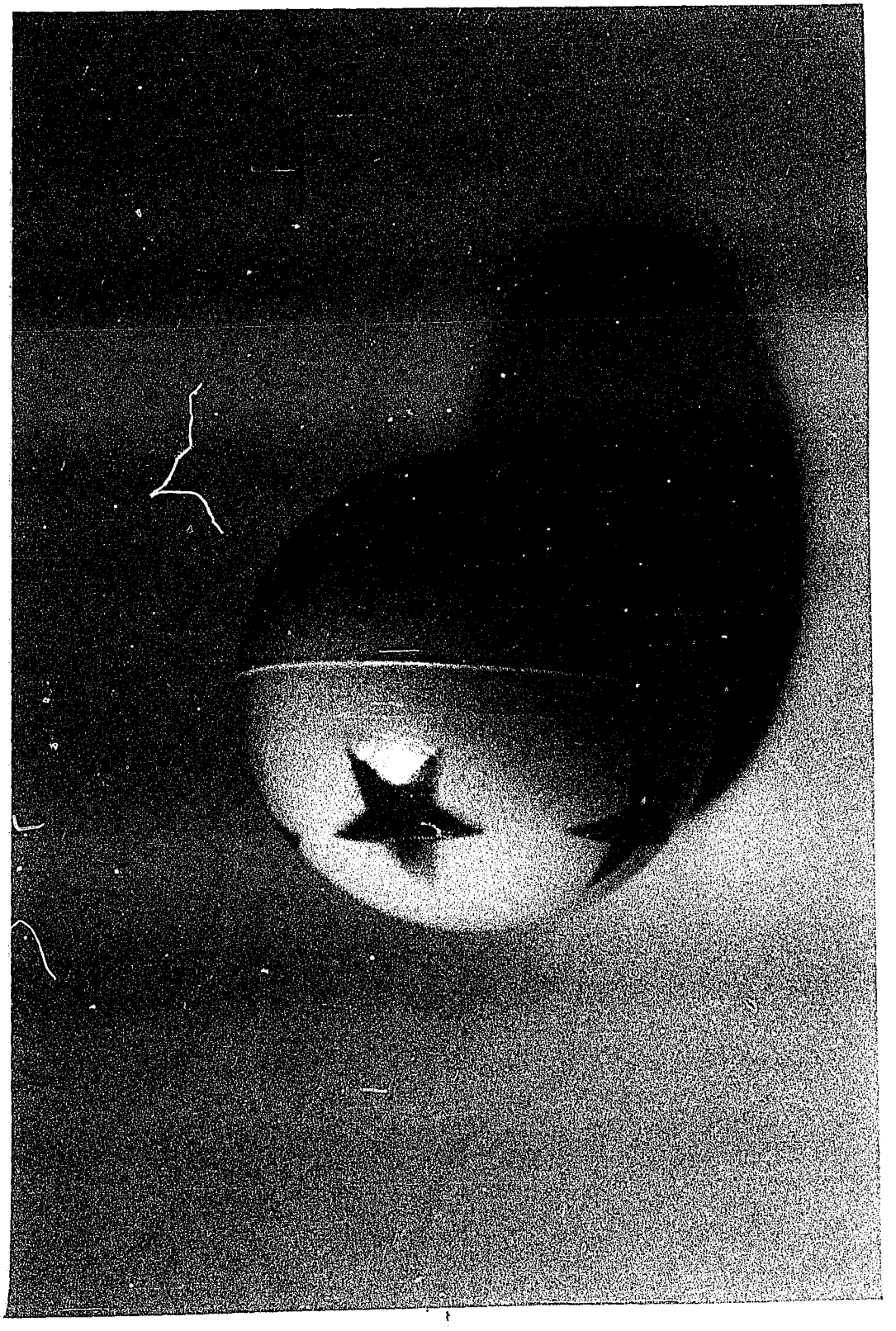

Appendix B

Follow-up Questions for Pictorial Stimuli

Stimulus	Initial Question	Follow-ups
Ice Cream	Can you eat this picture of an ice cream cone?	Why can (or can't) you do that? If I let you eat the picture of the ice cream cone, how would the picture taste? Would the picture taste like strawberry ice cream?
	If you touched the picture here, how would the picture feel? Would the picture feel cold?	Why would (or wouldn't) the picture feel cold?
Juice	Can you drink this picture of juice?	Why can (or can't) you do that? If I let you drink this picture of juice, how would the picture taste? Would the picture taste like orange juice?
	If you took this juice and drank it all up, would anything happen to the juice in the picture?	What would happen or why wouldn't anything happen?
Rose	If you took this rose and tore some of the leaves off, would anything happen to this picture?	What would happen or why wouldn't anything happen?
	If you got very close to this picture, how would the picture smell? Would the picture smell like a rose?	Why would (or wouldn't) the picture smell like a rose?
Candle	Can you blow out this picture of a candle?	Why can (or can't) you do that? If you blew on the picture here, would the fire go out?

Stimulus	Initial Questions	Follow-ups
Candle	If you touched the picture here, how would the picture feel? Would the picture feel hot?	Why would (or wouldn't) the picture feel hot?
Rattle	If you cut this picture in half, would anything happen to this rattle?	What would happen or why wouldn't anything happen?
	If you shook the picture, could you hear the rattle?	Why could (or couldn't) you hear the rattle?
Watch	If you cut this picture in half, would anything happen to this watch?	What could happen or why couldn't anything happen?
	If you got very close to this picture, could you hear the watch?	Why could (or couldn't) you hear the watch?
Crayon	Can you write with this picture of a crayon?	Why can (or can't) you do that? If you rubbed the picture of a crayon on a piece of paper, would the picture make a mark?
	If you took this crayon and broke it in half, would anything happen to the picture?	What would happen or why wouldn't anything happen?
Banana	Can you eat this picture of a banana?	Why can (or can't) you do that? If I let you eat the picture of a banana, how would the picture taste? Would the picture taste like a banana?

Stimulus	Initial Question	Follow-ups
Banana	If you got very close to this picture, how would the picture smell? Would the picture smell like a banana?	Why would (or wouldn't) the picture smell like a banana?
Ball	Can you bounce this picture of a ball?	Why can (or can't) you do that? If I let you throw the picture on the floor, would the picture bounce like a ball?
	If you cut this picture in half, would anything happen to this ball?	What would happen or why wouldn't anything happen?

Appendix C

Scoring Procedures for Photographic Knowledge Questions and Percentages for Response Categories (3-Year-Olds, 5-Year-Olds, All Subjects)

Question #	Description/Response Categories	Percentages 3 Yrs	5 Yrs	All Subj.
1	Do you know another name for picture?			
	(a) photo, photograph, film	3.3	6.7	5.0
	(b) IDK or nonsense, picture	73.3	73.3	73.3
	(c) content (e.g., juice, ice cream)	20.0	10.0	15.0
	(d) camera	0.0	3.3	1.7
	(e) other (e.g., book, coloring cards)	3.3	6.7	5.0

(Scoring: If response was "photograph" or "phcto," 2 points were given and question 2 was omitted. If response was "film," 1 point was credited and question 2 was administered. No credit was given for b through d.)

2	Have you ever heard of the word "photograph" or "photo"?			
	(a) yes	49.2	57.6	53.4
	(b) no	50.8	40.7	45.8
	(c) IDK	0.0	1.7	.8

(Scoring: One point was given for "a," all others received no credit.)

3	If someone asked you to tell them what a photograph is, what would you tell them?			
	(a) picture/film	18.3	40.0	29.2

Question #	Description/Response Categories	Percentages 3 Yrs	5 Yrs	All Subj.
3 (cont.)	If someone asked you to tell them what a photograph is, what would you tell them?			
	(b) picture plus (elaboration of "a," e.g., "a picture of something," "a picture or a photograph being shown on a screen")	0.0	5.0	2.5
	(c) IDK/no response, photograph, nonsense/ irrelevant	76.7	55.0	65.8
	(d) content (e.g., a flower, a man)	5.0	0.0	2.5

(Scoring: For "a," 1 point was credited; for "b," 2 points. All others received no credit).

4	What are photographs made of?			
	(a) paper, cardboard, film	16.9	41.7	29.4
	(b) content/pictures/colors (e.g., "Different colors... of birds or different colors of things," "of dead roses")	23.7	16.7	20.2
	(c) other materials (e.g., wood, plastic, glass, rubber, clay)	8.5	6.7	7.6
	(d) media confusion (confusion between photography and another media, e.g., coloring)	0.0	1.7	.8
	(e) IDK/no response/reiteration	39.0	28.3	33.6
	(f) camera	1.7	1.7	1.7
	(g) other (e.g., sticky, wire, plants)	10.2	3.3	6.7

(Scoring: For "a," 1 point was given. All others received no credit.)

Question #	Description/Response Categories	Percentages 3 Yrs	5 Yrs	All Subj.
5	Where do photographs come from?			
	(a) camera/projector	10.0	23.3	16.7
	(b) IDK/no response	41.7	20.0	30.8
	(c) location - Fotomat, camera stores	0.0	6.7	3.3
	(d) location, other (e.g., my school, mailbox, the store)	25.0	33.3	29.2
	(e) vague creation (photographs are created by man but doesn't specify mechanism, e.g.,"People make it.")	0.0	3.3	1.7
	(f) media confusion (confuses photography with another media, e.g.,"People and people color it.")	0.0	1.7	.8
	(g) other materials - trees, wood plastic	1.7	5.0	3.3
	(h) paper/film	1.7	3.3	2.5
	(i) other (e.g., the mailman, teachers, tape recorders)	20.0	3.3	11.7

(Scoring: This question was the first of a series probing the origin of photographs. If the response was "a," 4 points were credited and questions 6-8 were omitted. One point was credited for "c" or "e," which represent part of the correct answer and often preceded the response of "camera." All others received no credit.)

6	What do you have to do to get photographs?			
	(a) camera/projector	9.5	6.5	8.0
	(b) IDK/no response	42.9	34.8	38.6
	(c) location: Fotomat	0.0	8.7	4.5
	(d) location: other	16.7	21.7	19.3
	(e) vague creation	0.0	8.7	4.5

Question #	Description/Response Categories	Percentages 3 Yrs	5 Yrs	All Subj.
6 (cont.)	What do you have to do to get photographs?			
	(f) media confusion (e.g., "Just get a board and paint it white")	9.5	2.2	5.7
	(g) other (e.g., "From asking people," "buy them")	21.4	17.4	19.3

(Scoring: Second question in the series probing the origin of photographs. If response "a" was given, 3 points were given and questions 7-8 were omitted. One point was given for "c" or "e" if these responses were not credited earlier. All other responses received no credit.)

7	Let's say you wanted a picture of me, what would you do to get it?			
	(a) camera/projector	12.0	34.9	22.6
	(b) IDK/no response	42.0	18.6	31.2
	(c) location: Fotomat	0.0	2.3	1.1
	(d) location: other	18.0	9.3	14.0
	(e) vague creation	2.0	9.3	5.4
	(f) other (e.g., mailman, press tape-recorder)	26.0	25.6	25.8

(Scoring: Third question in the series probing the origin of photographs. If response was "a," 2 points were given and question 8 was omitted. One point was given for either "c" or "e" if these responses were not credited earlier. All other responses received no credit.)

8	Have you ever heard of something called a camera? What do you do with a camera?			
	(a) take pictures	90.2	96.4	92.8
	(b) IDK	9.8	3.6	7.2

(Scoring: Final question in the series probing the origin of photographs. Response "a" received 1 point.)

Question #	Description/Response Categories	Percentages 3 Yrs	5 Yrs	All Subj.
9	Does anyone in your family have a camera?			
	(a) yes	96.7	98.3	97.5
	(b) no	1.7	1.7	1.7
	(c) unclear	1.7	0.0	.8

(Scoring: Response "a" received 1 point. All other responses received no credit.)

10	After we take a picture with a camera, do we have to do anything else to get the picture?			
	(a) yes - process/develop (e.g., "Either it comes right out or you gotta wait or you gotta take to the shop to be developed")	28.1	55.0	41.9
	(b) no	49.1	33.3	41.0
	(c) other - actions related to picture-taking but out of sequence, thus omitting need for processing/developing (e.g., press button, put film in)	17.5	6.7	12.0
	(d) IDK/no response	3.5	5.0	4.3
	(e) nonsense/irrelevant	1.8	0.0	.9

(Scoring: Response "a" received 1 point; all other responses received no credit.)

11	What do your parents do with pictures after they take them?			
	(a) save/send/show - (e.g., "They put them in a picture book," "Save it to show to my cousin's mother")	36.8	35.6	36.2

Question #	Description/Response Categories	Percentages 3 Yrs	5 Yrs	All Subj.
11 (cont.)	What do your parents do with pictures after they take them?			
	(b) continue taking pictures	3.5	1.7	2.6
	(c) references to developing (e.g., pick up or bring to photo place- "They have to take them to the photo-shop and develop them and they pick them up two weeks after")	17.5	33.9	25.9
	(d) frame (e.g., "You get a picture frame to hang, to put it")	1.8	5.1	3.4
	(e) IDK/no response	15.8	20.3	18.1
	(f) nonsense/irrelevant (e.g., "put the camera away, go to the restaurant ")	21.1	3.4	12.1
	(g) both (c) references to processing/developing and (d) frame	1.8	0.0	.9
	(h) both (a) save/send/show and (c) references to processing/developing	1.8	0.0	.9

(Scoring: Responses "a" and "d" both received 1 point. Since this question could be interpreted as a request for information about developing and processing, children were given 1 point for "c" if they did not receive credit for this knowledge on question 10. Two points were credited for either "g" or "h" which contained references to two different response categories within a single explanation if the child did not receive credit for references to processing/developing on question 10).

12	Have you ever used a camera?			
	(a) yes	25.9	35.0	30.5
	(b) no	69.0	61.7	65.3
	(c) unclear/unsure	5.2	3.3	4.2

(Scoring: Response "a" received 1 point. All others received no credit.)

Question #	Description/Response Categories	Percentages 3 Yrs	5 Yrs	All Subj.
13	Why do you think people take pictures?			
	(a) aesthetics (of subject matter or for decorative use in the home, e.g.,"To make their houses pretty," "because if someone looks nice")	5.2	3.3	4.2
	(b) occasion/sentiment - (e.g., "Cause on birthdays you could," "Maybe if they like something, they take a picture of it")	8.6	8.3	8.5
	(c) surrogate/record (e.g., "To see them, to show different people, to show your friends the pictures," "To remind them of things")	8.6	20.0	14.4
	(d) send to someone	0.0	1.7	.8
	(e) want/like to	32.8	25.0	28.8
	(f) IDK/irrelevant (e.g., "Cause they're big people," "Cause my daddy does")	44.8	36.7	40.7
	(g) both (a) aesthetics and (c) surrogate/record	0.0	3.3	1.7
	(h) both (a) aesthetics and (d) send to someone	0.0	1.7	.8

(Scoring: Responses "a," "b," "c," and "d" each received 1 point. Responses "g" and "h," consisting of references to two different responses within a single explanation, each received 2 points. Responses "e" and "f" received no credit.)

14	Besides the pictures we talked about today, have you ever seen any other photographs like this?			
	(a) yes	20.3	43.3	31.9
	(b) no	72.9	53.3	63.0
	(c) unclear or unsure	6.8	3.3	5.0

Question #	Description/Response Categories	Percentages 3 Yrs	5 Yrs	All Subj.
14 (cont.)	Besides the pictures we talked about today, have you ever seen any other photographs like this?			
(Scoring: Response "a" received 1 point; all others received no credit.)				
15	When someone takes a picture of a watch, is the watch in the picture the same as the real watch or is it different?			
	(a) different	76.3	65.0	70.6
	(b) same	15.3	26.7	21.0
	(c) both same and different (right)	0.0	3.3	1.7
	(d) IDK	8.5	5.0	6.7
(Scoring: One point was given for either response "a" or "c". All others received no credit.)				
16	Follow-up to Question 15: How is it different (the same)?			
	(a) different-function (e.g., "Because we can wear the watch," i.e., the referent)	1.9	0.0	.9
	(b) different-size/shape (Child motioned and said, "It means it's a different shape")	0.0	1.8	.9
	(c) different-symbol/real (e.g,. "Because one watch isn't real because it's, like, a picture of a watch")	11.1	29.8	20.7
	(d) different-color (e.g., "Because it's white and the other is grey")	7.4	1.8	4.5

Question #	Description/Response Categories	Percentages 3 Yrs	5 Yrs	All Subj.
16 (cont.)	Follow-up to Question 15: How is it different (the same?)			
	(e) different-flatness (e.g., "Because that's in back and that's in front, right [the referent] and in front only, that one is [picture]"	0.0	1.8	.9
	(f) different-soundless (e.g., "Because it don't have thing make ... it don't tick")	3.7	0.0	1.8
	(g) different-ambiguous (e.g., "Like a different camera")	14.8	5.3	9.9
	(h) different-IDK	31.5	17.5	24.3
	(i) different-symbol/real, function (e.g.,"Because the watch on the screen you can't put on, but the watch that was right here you could put on")	0.0	1.8	.9
	(j) different-symbol/real, color (e.g., "The other one's grey and the real one's black")	3.7	0.0	1.8
	(k) different-symbol/real, immobile (e.g.,"The other watch doesn't move ... the one that's in the picture")	1.9	0.0	.9
	(l) different-symbol/real, flatness	0.0	1.8	.9
	(m) different-symbol/real, soundless (e.g., "Because the one in the picture's not real so it won't make noises")	7.4	1.8	4.5
	(n) different-symbol/real, tangibility (e.g., "Because the one that's on the picture you can't feel and the one that's not you could feel")	0.0	5.3	2.7

Question #	Description/Response Categories	Percentages 3 Yrs	5 Yrs	All Subj.
16 (cont.)	Follow-up to Question 15: How is it different (the same)?			
	(o) different-symbol/real, function, soundless (e.g., "Because it's not real and when you want to listen to it, it wouldn't sound like anything and you couldn't wear it like a real watch")	0.0	1.8	.9
	(p) both same and different - content same, immobile (e.g., "It's the same cause you're taking a picture of that watch and it's the same. It's different because it's still")	0.0	1.8	.9
	(q) same-same content (e.g., "Because if they take a picture of one watch, the same watch will come into the picture and that's all really")	7.4	8.8	8.1
	(r) same-color and/or size relationships preserved (e.g., "It has the same color ... that if we take a picture of someone far away, it would still be tiny")	3.7	3.5	3.6
	(s) same-ambiguous (e.g., "When something is just like the other")	1.9	3.5	2.7
	(t) same-IDK	3.7	12.3	8.1

(Scoring: Responses "a" through "f" received 1 point. Responses "i" through "n," which made reference to two different categories within a single explanation, each received 2 points. Response "o," which touched upon three separate categories, received 3 points. Response "p," in which children specified ways in which photographs are both the same and different received 2 points. All other responses received no credit.)

Question #	Description/Response Categories	Percentages 3 Yrs	5 Yrs	All Subj.
17	Do you know what a drawing is? Where do drawings come from?			
	(a) creator (e.g., "You draw them," "From people")	8.5	11.7	10.1
	(b) materials (e.g., "Drawings come from a box of crayons")	20.3	20.0	20.2
	(c) process (elaborates on the the nature of drawing, e.g., "A drawing is coloring," "like writing")	5.1	1.7	3.4
	(d) generic picture (e.g., "It's a picture.")	3.4	1.7	2.5
	(e) creator and generic picture (e.g., "Someone draws a picture of someone")	0.0	8.3	4.2
	(f) creator and materials (e.g., "Something that someone made ... with a piece of paper and crayons")	15.3	20.0	17.6
	(g) creator and process (e.g., "Drawings come from when you write with your hand")	6.8	3.3	5.0
	(h) process and materials (e.g., Writing ... from a pencil, a crayon, and a pen")	1.7	1.7	1.7
	(i) generic picture, materials (e.g., "Pictures on a piece of paper")	3.4	1.7	2.5
	(j) creator, process, and materials (e.g.,"You take a pen, you write on a piece of paper")	5.1	5.0	5.0
	(k) creator, process, generic picture (e.g., "You write and then the drawing comes out, it's a picture")	3.4	1.7	2.5

Question #	Description/Response Categories	Percentages 3 Yrs	5 Yrs	All Subj.
17 (cont.)	Do you know what a drawing is? Where do drawings come from?			
	(l) generic picture, process, materials (e.g., "A picture ... coloring in with magic markers and painting")	0.0	1.7	.8
	(m) creator, generic picture, materials (e.g., "When someone wants to give someone a drawing, they draw a picture with crayons and paper")	0.0.	1.7	.8
	(n) creator, materials, process, generic picture (e.g., "It's a picture of something that people make by hand with crayons or pens")	1.7	3.3	2.5
	(o) IDK	22.0	13.3	17.6
	(p) media confusion (e.g., cameras)	1.7	0.0	.8
	(q) other (e.g., store, God)	1.7	3.3	2.5

(Scoring: Responses "a" through "d" each received 1 point. Responses "e" through "i," various combinations of two categories, each received 2 points. Responses "j" through "m," various combinations of three categories, each received 3 points. Response "n" made reference to all four categories, for a total of 4 points. Responses "o" through "q" received no credit. For those unable to give any indication of the origin of drawings, as in responses "o" through "q," questions 18-21 were omitted and no credit was assigned for these items. This procedure was based on pilot work indicating that children lacking knowledge of the origin of drawings did not appear to understand the remaining items in the series, and did not, in fact, receive credit for these items.)

Question #	Description/Response Categories	Percentages 3 Yrs	5 Yrs	All Subj.
18	Is a drawing the same as a photograph?			
	(a) yes	33.3	14.8	23.5
	(b) no	60.5	70.4	65.7
	(c) both same and different (right)	0.0	3.7	2.0
	(d) both same and different (wrong)	0.0	3.7	2.0
	(e) IDK	6.3	7.4	6.9

(Scoring: Responses "a" and "c" each received 1 point. All others received no credit.)

19	Follow-up to Question 18: (If no) How is it different?			
	(a) both processes correct (e.g., "Cause a picture's made with a crayon or a pencil, and a photograph is done with a camera")	3.4	22.5	14.5
	(b) one process correct (e.g., "You have to color with crayons [drawings] and a photograph you have to look at," "Cause pictures you have to develop and drawings you don't")	3.4	17.5	11.6
	(c) media confusion (e..g, "Because you use a pen for a photograph and a crayon for coloring")	3.4	10.0	7.2
	(d) ambiguous/idiosyncratic (e.g., "Because a photograph is bigger and people in it")	55.2	22.5	36.2
	(e) IDK	34.5	27.5	30.4

(Scoring: Response "a" received 2 points; response "b" received 1 point. All other responses received no credit.)

Question #	Description/Response Categories	Percentages 3 Yrs	5 Yrs	All Subj.
20	Which would look more like a truck, a drawing you made of the truck or a photograph of the truck?			
	(a) photograph	68.1	52.9	60.2
	(b) drawing	12.8	25.5	19.4
	(c) both same	0.0	9.8	5.1
	(d) IDK/irrelevant (e.g., a real truck)	19.1	11.8	15.3
(Scoring: Response "a" received 1 point. All others received no credit.)				
21	Follow-up to Question 20: Why?			
	If photograph chosen:			
	(a) resemblance/realism (e.g., "Cause it looks like a real truck")	2.7	10.0	6.5
	(b) vague sameness (e.g., "Because it has the same shape, "Cause it was the same as a truck")	5.4	10.0	7.8
	(c) ambiguous/idiosyncratic	40.5	20.0	29.9
	(d) IDK/no response	35.1	25.0	29.9
	If drawing chosen:			
	(e) resemblance/realism (e.g., "Because it would be a color and it would look much more like a real truck")	0.0	5.0	2.6
	(f) aesthetics(e.g., "Cause it look prettier")	0.0	2.5	1.3
	(g) ambiguous/idiosyncratic (e.g., "Cause it straightens out better")	8.1	10.0	9.1
	(h) IDK/no response	8.1	15.0	11.7

Question #	Description/Response Categories	Percentages 3 Yrs	5 Yrs	All Subj.
21 (cont.)	Follow-up to Question 20: Why?			
	If both chosen:			
	(i) resemblance/realism	0.0	2.5	1.3

(Scoring: Response "a" received 2 points. Response "b" received 1 point. All others received no credit.)

Note: Percentages were adjusted for missing cases. Each entry thus represents the percentages of subjects who chose a given response category out of those answering that particular question. Columns may not add to 100 due to rounding error.

Appendix D

Table A

Analyses of Variance (Representational Medium x Mode x Sex x Age) for Total Iconic Realism Scores and Subscores (Iconic Subjects, Phase I)

Source	df	Total Iconic		Functional		Existence		Phys. Property	
		MS	F	MS	F	MS	F	MS	F
Representational Medium	1	21.44	2.74	.03	.06	17.86	6.49*	.34	.12
Mode	1	.03	.00	.31	.56	1.91	.69	.99	.35
Sex	1	.41	.05	.11	.21	.65	.24	1.23	.44
Age	1	15.16	1.94	.14	.25	7.20	2.62	.71	.25
Rep. Medium x Mode	1	4.11	.52	.68	1.24	3.63	1.31	.50	.18
Rep. Medium x Sex	1	4.32	.55	.57	1.04	.00	.00	1.76	.63
Rep. Medium x Age	1	1.11	.14	1.43	2.61	1.08	.39	1.46	.52
Mode x Sex	1	.70	.09	1.76	3.20	.68	.25	.12	.04
Mode x Age	1	.01	.00	.88	1.60	.42	.15	2.18	.78

Table A (Continued)

(Page 2 of 2)

Source	df	Total Iconic		Functional		Existence		Phys. Property	
		MS	F	MS	F	MS	F	MS	F
Sex x Age	1	2.74	.35	.16	.29	.49	.18	.31	.11
Rep. Medium x Mode x Sex	1	5.50	.70	2.03	3.70	.13	.05	1.64	.58
Rep. Medium x Mode x Age	1	27.76	3.55	3.50	6.37*	1.26	.46	5.18	1.85
Rep. Medium x Sex x Age	1	12.88	1.64	3.52	6.41*	.04	.01	2.33	.83
Mode X Sex X Age	1	.38	.05	.68	1.24	.24	.08	.92	.33
Rep. Medium x Mode x Sex x Age	1	3.49	.45	1.60	2.90	.73	.26	2.12	.76
Within Subject	56	7.83	--	.55	--	2.75	--	2.80	--

*$p < .05$.

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