INFORMATION TO USERS

This reproduction was made from a copy of a document sent to us for microfilming. While the most advanced technology has been used to photograph and reproduce this document, the quality of the reproduction is heavily dependent upon the quality of the material submitted.

The following explanation of techniques is provided to help clarify markings or notations which may appear on this reproduction.

1. The sign or "target" for pages apparently lacking from the document photographed is "Missing Page(s)". If it was possible to obtain the missing page(s) or section, they are spliced into the film along with adjacent pages. This may have necessitated cutting through an image and duplicating adjacent pages to assure complete continuity.

2. When an image on the film is obliterated with a round black mark, it is an indication of either blurred copy because of movement during exposure, duplicate copy, or copyrighted materials that should not have been filmed. For blurred pages, a good image of the page can be found in the adjacent frame. If copyrighted materials were deleted, a target note will appear listing the pages in the adjacent frame.

3. When a map, drawing or chart, etc., is part of the material being photographed, a definite method of "sectioning" the material has been followed. It is customary to begin filming at the upper left hand corner of a large sheet and to continue from left to right in equal sections with small overlaps. If necessary, sectioning is continued again—beginning below the first row and continuing on until complete.

4. For illustrations that cannot be satisfactorily reproduced by xerographic means, photographic prints can be purchased at additional cost and inserted into your xerographic copy. These prints are available upon request from the Dissertations Customer Services Department.

5. Some pages in any document may have indistinct print. In all cases the best available copy has been filmed.

University Microfilms International
300 N. Zeeb Road
Ann Arbor, MI 48106

Kose, Gary

CHILDREN'S THINKING ABOUT PHOTOGRAPHY: A STUDY OF THE DEVELOPING AWARENESS OF A REPRESENTATIONAL MEDIUM

City University of New York PH.D. 1982

CHILDREN'S THINKING ABOUT PHOTOGRAPHY: A STUDY OF THE DEVELOPING AWARENESS OF A REPRESENTATIONAL MEDIUM

by

GARY KOSE

A dissertation submitted to the Graduate Faculty in Developmental Psychology in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York.

1982

This manuscript has been read and accepted for the Graduate Faculty in Psychology in satisfaction of the dissertation for the degree of Doctor of Philosophy.

May 13, 1982
date

Chairman of Examining Committee

May 13 1982
date

Executive Officer

Kathrine Nelson

Joseph Glick

Harry Beilin

Supervisory Committee

The City University of New York

Abstract

CHILDREN'S THINKING ABOUT PHOTOGRAPHY:
A STUDY OF THE DEVELOPING AWARENESS
OF A REPRESENTATIONAL MEDIUM

by

Gary Kose

Advisor: Professor Harry Beilin

This study is concerned with the nature of representation and the effects of the media on the comprehension of pictorial information. It is argued that a psychological account of picture perception requires consideration of the perceiver's knowledge of the depicted content, and knowledge as well of the medium of expression. The study examines the characteristics of thought about the nature and functions of the photographic medium and its role in the comprehension of information contained in photographs. The influence of general cognitive abilities and specific experience with photography on this thought is also examined.

Children eight-and twelve-years of age were measured on a series of Piagetian tasks and distinguished on the basis of their participation in a school photography course. They were interviewed with regard to the nature of photography and were then asked to respond to a series of photographs.

The children's responses to the interview and the photographs were coded into four general categories: discussing concerns about the contents depicted in the photographs, discussing the characteristics of the photographic medium, discussing the interaction of content and medium, and a discussion of the intentions of the photographer.

The results indicate that when responding to interview questions, the eight-year-old children discuss either the depicted content or the characteristics of the medium. Difference in general cognitive skills does not influence their responses. Experience with photography increases the tendency to discuss medium limitation. When responding to the photographs, the eight-year-olds showed the strongest tendency to discuss the depicted content. Similar to their responses in the interview, cognitive skills had no effect and experience with photography increases the discussion of medium limitations.

The twelve-year-old children responded to the interview questions by discussing the interaction of content and medium. This tendency was strongest for the formal operational children. There was no effect for experience with photography. When responding to the photographs, these children vary their responses with differences in photographic style and demonstrated an ability to discuss the interaction of content and medium for certain types of photographs. Experience with

photography and differences in cognitive level both affected the type of responses given.

These findings are discussed as distinct from perceptual and cognitive processes involved in understanding physical substances and properties. Instead, thinking about photography requires an understanding of the indeterminate relationship between the components of this phenomenon, their manipulation to the purposes of individual expression, and the influence of relevant experience on this conceptualization.

Acknowledgements

I would like to express my sincere appreciation to the faculty and students of the Developmental Psychology Program for providing a rich surrounding for living with one's ideas. I would like to especially thank Dr.Harry Beilin for his role in the initiation and completion of this work, but more importantly I would like to acknowledge his influence on me throughout my graduate education. I would also like to thank Dr. Joseph Glick, not only for his intellectual guidance, but also for his friendship and support.

I would also like to express my appreciation to Mr. Carlin Uritsky, of the Little Red School House, and Dr. Samuel Ross and Mr. Joseph Whalen, of the Green Chimney School for their cooperation and hospitality during the collection of the data; and to Mrs. Carolyn Van Ness for her work in typing the manuscript. Finally, a special note of thanks to Ms. Linda Slingland for her comments and support during this work.

TABLE OF CONTENTS

LIST OF TABLES

List of Tables, cont.

Children's Thinking About Photography: A Study of the Developing Awareness of a Representational Medium

This investigation begins by considering the way one object comes to stand for, or represent another. This issue is familiar to psychological literature and has been discussed in a number of classic works (e.g., Piaget, 1962; Werner & Kaplan, 1963; Bruner, 1964) which outline the developmental process involved in children's understanding and use of symbols. These accounts focus on developing the general processes, and direct only secondary interest to the influence of specific symbolic media. The present study contends that further elaboration on the nature of symbolic functioning requires consideration of the influence of specific media characteristics as an integral part of any investigation. Such an approach has been suggested in the work of Olson (1970; 1974) and Soloman (1980); has been argued by McLuhan (1964) and has been a tradition of the Prague School of Semiotics (Matejka & Titunik, 1977), maintaining that any sign or symbol is influenced or altered by its specific means of expression.

The specific medium to be examined in this study is pictorial and the way in which it can be used to represent. Despite the continued interest and use of pictures in psychological research, there are few theoretical accounts

of how pictures are perceived and comprehended. Many of the positions to be reviewed are drawn from philosophical and artistic, as well as psychological arguments attempting to explain pictures. An important issue which makes it difficult to organize theoretical accounts of pictures is the wide range of definitions delimiting the phenomenon. Some accounts set the task of elaborating the structure of the physical characteristics of pictures per se (e.g., Hagen, 1980); while others attempt to explain pictures as the adoption of a pictorial attitude or way of seeing physical reality (e.g., Wartofsky, 1980). This discussion of the perception and comprehension of pictures will be framed by considering two radically different accounts proposed by J.J. Gibson and Nelson Goodman. Both offer explanations of the way pictures represent reality; however, very different assumptions about the nature of representation underlie their respective accounts and consequently suggest different processes necessary for an understanding of pictures.

Theoretical Overview

Gibson focuses primarily on the perception of pictorial information as an explanation of how pictures are understood. Picture perception is a result of the perceiver picking up corresponding optical information existing between a picture and its referent:

> A picture is a surface so treated that a delimited optic array to a point of observation is made available that contains the same kind of information that is found in the ambient optic array of an ordinary environment (1971, p.31).

This definition is different from Gibson's (1952) earlier point projection theory of picture perception, which explains the recognition of pictures via the pick up of identical light rays from the picture and its referent. In this new formulation, the light energy and sensation picked up from a picture can be very different from the light sensation picked up from the picture's real world referent, as in a line drawing or a caricature, but still convey equivalent informational units that allow the perceiver to establish the identity of the picture. The orgins of these equivalent informational units are the "...invariants in the optical array that specify the distinctive features of an object (1971, p.34)."

Gibson, thus, proposes that a picture refers to its referent by way of equivalent corresponding units of optical information, and it is not the case that the picture "re-presents" reality; i.e., tricks the perceiver into thinking he is looking at a real scene (1979). For example, Gibson points out that an adult can adopt either a naive attitude or perspectival attitude towards a picture, so that when viewing an enlarged photograph of a scene, the adult can indicate his approximate distance from both the photographic

surface as well as his distance from an object depicted in the scene.

Nelson Goodman's discussion of the structure of symbol systems, presented in the Languages of Art (1968), begins by considering the nature of representation and uses pictures as a vehicle for making his argument. Goodman agrees with Gibson that there is a clear distinction between the information presented in a picture and corresponding information in the real world, but goes further in arguing against the necessity of corresponding optical information in explaining how a picture is related to its referent. The representational character of a picture is established by conventional and habitual ways of seeing, and no degree of resemblance is needed.

> The plain fact is that a picture, to represent an object must be a symbol for it, stand for it, refer to it; and that no degree of resemblance is sufficient to establish the requisite relationships for reference. Nor is resemblance necessary for reference; almost anything can stand for anything else. A picture that represents like a passage that describes an object refers to and, more particularly denotes it. Denotation is the core of representation (p. 5).

This relationship between a picture and its referent, established by convention, specifies how a picture is created as well as perceived and interpreted. Goodman describes, "...the artist's task in representing an object before him is to decide what light rays, under gallery conditions, will succeed in rendering

what he sees. This is not a matter of copying but conveying (p. 14)." This information presented in a picture is determined by accepted conventions and habits of seeing and must be read in a way analogous to reading a verbal description. Even realism in pictures is but one selected view of an array of information.

A direct comparison of Gibson's and Goodman's positions place them in direct opposition (e.g., see Friedman, 1980). Two major distinctions exist between these positions. The first distinction concerns the source of pictorial information. In Gibson's account, the information available in a picture is delimited by the perceptual information contained in the surrounding environment. A picture that can be comprehended must contain information that is equivalent in some way with the optical information present in the perceiver's actual environment. For Goodman, on the other hand, the source of information is delimited not by the physical environment, but by the social or cultural environment, so that in terms of physical resemblance, anything can stand for anything else. Representation is achieved instead by knowing what stands for what within a particular conventional system.

The second major distinction between Gibson's and Goodman's positions is the processes by which pictures are comprehended. Gibson contends that understanding the

information presented in pictures is exclusively a perceptual process. An organism's perceptual adaptation and familarity with his physical surroundings is sufficient for processing the information contained in pictures. Studies demonstrating very young children's ability to recognize pictures of familiar objects and people (Hochberg & Brooks, 1962; Dirks & Gibson, 1977) support such a position. For Goodman, understanding pictures implies a cognitive process by which the perceiver interprets the pictorial symbols according to socio-cultural conventions. This process would seem to involve learning and require time for an organism to become familiar with accepted standards of pictorial representation. Cross cultural studies of picture perception support this position, demonstrating that people raised in cultures devoid of pictorial representation have difficulty understanding information presented in pictures; however, recent work has brought these findings into question (see Hagen & Jones, 1980 for a review).

Despite these two important distinctions, a critical examination of these positions reveals a number of similar ambiguities that remain unresolved. First, both positions employ rather vague terms to explain pictorial representation. In Gibson's notion of corresponding optical information, it is not clear exactly what optical information is needed by a perceiver to identify a picture. Similarly, Goodman's use

of the term denotation, although philosophically valid, provides little psychological understanding of pictures. It seems obvious that perceptual information is used to identify pictures and in many instances by establishing resemblance. Both positions lack an account of the possible criteria used by the perceiver to establish a representational relationship between a picture and its referent. It seems that a more complete account of pictures necessitates consideration of the internal system of information accessed by the perceiver in establishing the representational characteristic of pictures, whether it is perceptual or conventional in origin.

A second issue is that for both Gibson and Goodman, pictorial representation is explained as a one-way relationship between the picture and its referent, in that pictures can be comprehended only if the perceiver possesses appropriate information from either the surrounding environment or of accepted conventions. It is difficult for either position to explain how pictures can provide novel information to the perceiver (Novitz, 1977). For example, a painting can suggest a novel way of looking at an object, an artistic style can suggest a different way of viewing all of reality, an X-ray photograph can make a referent more available for observation and a photograph taken with an electron-microscope can reveal information that cannot be seen

under normal viewing conditions. Providing a copy of known reality is only one function pictures can serve, and their ability to provide new information which seems to be a common practical function needs further theoretical elaboration.

Finally, neither Gibson nor Goodman indicates what information is necessary to distinguish a pictorial representation from other forms of visual expression that serve similar functions, e.g., sculpture, or an exact replica. Both positions recognize the distinctions between pictures and reality, but make no mention of distinctions among other related media. This consideration begs the question, provided there are such distinctions, of the importance of the unique characteristics of a medium in comprehending meaning (see Soloman, 1979).

In sum, this review has examined Gibson's perceptual account of comprehending the information presented in pictures and Nelson Goodman's symbolic interpretation of pictures as radically opposed positions. Two major distinctions were noted. The first concerned the source of pictorial information; for Gibson, the information presented in pictures must originate in some way from the perceptual information present in the surrounding environment, whereas for Goodman, pictorial information is determined by socio-cultural conventions. The second distinction involved the processing of pictorial information. Gibson argues that the process is exclusively

perceptual, while for Goodman, comprehending pictures is an interpretive process analogous to reading. More important than pointing out the distinctions between Gibson's and Goodman's accounts, this brief review has outlined three areas that are important to an accurate psychological account of pictures that have not been elucidated by these two major theories. The first area concerns the problem of specifying the information necessary for the perceiver to establish a representational relationship between a picture and its referent, be it optical or conventional. The second issue involves elaborating the ways in which pictorial information can function. Both Gibson and Goodman discuss pictures as something that reflects already acquired information, however, it was pointed out that pictures can also function in providing new information. This function as well as the possibility of other functions have not been considered. Finally, in neither account has there been a discussion of the unique characteristics that distinguish pictorial representation from other visual media, and if and how such distinctions could influence the comprehension of a picture's meaning. All three areas of concern seem to necessitate an account of the perceiver's internal knowledge or ability to think about pictorial forms. Specifically, thinking about pictures at least involves consideration of the three issues mentioned: what criterion will be used for establishing the

picture's relationship to reality, how is the pictorial information going to be used, and what characteristics distinguish pictorial information from other forms of representation, and do these distinctions influence the comprehension of meaning.

Theoretical Orientation

There are a number of intermediate theories of pictures which fall between the empiricism of Gibson's ecological optics and the nominalism of Goodman's symbolic interpretation, which suggest a more interactive account of the role of external reality and interpretive processes. Hochberg (1970), for example, elaborates the nature of the perceptual processes involved in picture perception. According to Hochberg, picture perception involves the perceiver's active selection of visual input by way of a succession of perceptual glimpses or scenes. Recognition of a picture is a process of perceptual discovery, guided by past experiences and the nature of the perceived stimulus. The selection of information, as in Gibson's position, is not determined by conventional standards, but must correspond with what is normally perceived in the surrounding environment.

Arnheim (1967; 1974), in the Gestaltist tradition, also elaborates on the nature of perception, and in his notion of "visual thinking" endows perception with fundamental cognitive

abilities such as abstraction and classification. With regard to pictorial representation, Arnheim suggests three forms of visual images requiring different levels of abstraction, i.e., having different representational relationships to their referents, and consequently, serving different functions for the perceiver. Signs, the first form, are representations at the lowest level of abstraction which represent by presenting information that is an inherent part of the referent. Pictures are at an intermediate level of abstraction which render relevant qualities of the referent. Symbols are the most abstract form of visual representation completely controlled by the viewer and are arbitrary because they are not generic to the referent. How a perceiver distinguishes these forms of visual images, i.e., whether the distinctions are part of the images or are judgments made by the perceiver, is never clearly addressed. Arnheim, in addition, has given attention to the specific nature of various media and has in other works discussed the visual effects unique to film (1957) and photography (1974). Although Arnheim has made important distinctions between levels of representation, and the unique characteristics of media, he has not integrated these facets in providing a coherent explanation of the perception and understanding of pictures.

Gombrich's (1961) analysis of the nature of pictorial representation seems to be a more sophisticated and subtle

elaboration. Gombrich accounts for perception, similar to Gibson, as a process programmed to pick-up important natural features of the surrounding environment. Experience results in expectations that allow the perceiver to make judgments about meaning. These perceptual expectations constitute what Gombrich refers to as the "Beholder's Share." With regard to pictorial representations, Gombrich proposes that the creators of pictures, i.e., artists, invent rules or "schemata" for putting clues down on a picture's surface which then elicits the beholder's share to interpret meaning. Gombrich's evidence of these rules or schemata is presented in his account of the history of art. Contrary to the traditional view that the history of art reflects the various ways man conceptualized reality, Gombrich contends that the evolution of various artistic styles reflect the "vocabularies" used in pictorial representations to elicit the perceiver's interpretation:

> The history of art, as we have interpreted it so far may be described as the forging of master keys for opening mysterious locks of our senses... There are inventions in the history of art that have something of the character of such an open sesame. Foreshortening maybe one of them in the way it produces the impression of depth... the question is not whether nature "really looks" like these pictorial devices but whether pictures with such features suggest a reading in terms of natural objects. Admittedly the degree to which they do depends to some extent on what we call mental set. We respond differently when we are keyed up by expectations, by need, and by cultural habituation. All these factors may affect the preliminary setting of the lock but not it's opening, which still depends on turning the right key (p. 360).

For Gombrich, the analysis of pictorial representation requires an account of the artist's or perceiver's internal "mental set." This is composed of knowledge and expectations about the real world, i.e., the beholder's share, plus knowledge of accepted pictorial "vocabularies." Pictorial representation is accomplished when the problem of equivalence is solved between the perceiver's or artist's knowledge of the world and the appropriate pictorial devices.

Gombrich's proposal suggests an account of pictorial representation that is achieved not merely by the presence of external perceptual or conventional information, but rather by an active cognitive process whereby the perceiver makes a judgement of representation based on his ability to coordinate his expectations about reality with his knowledge of the possible forms of pictorial expression.

Snyder (1980), although in general agreement with Gombrich's proposal, questions his conception of perceptual processes programmed to pick-up important natural features of the environment. Snyder points out that Gombrich's interactive explanation of perceiving and understanding pictures is based, as is Gibson's position, on the perceiver's ability to match the picture with the real world. Thus, Gombrich only postpones the criticism addressed to Gibson concerning the natural or privileged relations between a picture and its referent in the world of actual objects.

Snyder, like Goodman, believes that the perceptual correspondence between even the most realistic picture and its referent is too variable and indeterminate to be taken seriously as a basis for representation. However, Snyder stresses that Goodman's explanation of pictorial representation as convention is too weak to account for the ease of picking up pictorial information or the strength of a picture's realism. Snyder attempts to elaborate on the source and nature of the perceiver's belief in a pictorial convention. Snyder contends that pictorial representation "...is conceptually and historically based upon the adoption of a model that permits both picture maker and viewer to demand and, indeed, to find systematic relations between picture and object of depiction (p. 503)." Snyder refers to "picturing vision" as dependent on primarily two factors, the purpose of representation, and the expressive requirements needed to create a picture. The former involves consideration of why a particular picture was created and what functions it is to serve; while the latter suggests knowledge of the pictorial devices or vocabularies used for depiction, as discussed by Gombrich. The choice to see an object as a picture, based on knowledge of the purpose of representation and the requirements for expression necessitates an understanding of the reciprocal relationship between seeing and creating pictures. An awareness of this relationship involves the creator of a

picture anticipating the viewing capacity of the perspective audience, i.e., their knowledge of the world, knowledge of pictorial expression, and the ways they are likely to use the picture; while the audience attempts to determine the intentions of the creator, i.e., his knowledge of the world, of perspective audiences, and of pictorial conventions and means of expression.

Novitz (1977) proposes a very similar account of picture representation. His argument is based on the distinction between pictures, per se, and their various uses. One very common function for pictures is to represent reality, however, Novitz stresses that this is not the exclusive function of pictures. For example, the Mona Lisa can serve a variety of functions, such as a representation of a specific friend of DaVinci, a substitute for one's beloved, a symbol of national pride or an illustration of the topography of a geographic location (p. 7). Pictures are objects that can be described as one place predicates, e.g., a Mona Lisa picture, which may be used in many radically different ways. Using a picture to represent, a very common function of pictures is for the creator or perceiver, an intentional act. Thus, knowledge of the various functions a picture can serve is requisite to picture creation and comprehension. Each function distinguishes what aspects of the picture should be attended to, thus physical resemblance maybe the basis for

using a picture to represent an object while a conventional relationship may exist between an art work and an artist's conception. In sum, Novitz distinguishes two factors as essential to comprehending pictures: first, a perceiver must be aware that he is looking at a picture cued by pictorial means of expression for the possible functions it may serve; secondly, he must distinguish one of the possible functions as appropriate for a particular picture to allow an interpretation. Thus, as in Snyder's account, Novitz proposes that seeing and comprehending a picture involves knowledge of the requirements for expression and the purpose of the pictorial representation. For Novitz, this knowledge is acquired by experience with the pictorial medium, via encounters with pictures in various contexts, e.g., pictures with titles, in galleries, in magazines, in family albums, or by experience with the process of creating pictures. Such experiences serve in signaling to the perceiver the way he can understand the intentions behind the construction of a picture.

Thus, having reviewed Gibson's and Goodman's position on the nature of pictures, it has been argued that accounts of both the external optical and conventional characteristics of pictures leaves a number of unresolved questions. An accurate psychological account of picture perception necessitates consideration of the perceiver's knowledge or

ability to think about pictorial forms. In discussing the various interactionist explanations of pictorial representation of Gombrich, Snyder and Novitz, it has been suggested that understanding pictorial representation involves primarily the processing of pictorial devices or vocabularies, i.e., information that constitutes a picture and the requirements for pictorial expression, and secondly, an awareness of the possible functions that pictures can serve. This information and skill is acquired through experience with pictures, by viewing pictures in various contexts or by experiencing in some way the process of creating pictures. Such experiences highlight the reciprocal relationship existing between the perceiver and creator and the co-ordination of their intentions that are implicit in the comprehension of a picture.

Review of Empirical Evidence

Stressing an awareness of the means of expression and functions of the pictorial medium in explaining picture comprehension, has interesting implications for the available psychological literature on picture perception. Generally, research has indicated that picture perception is a naive ability, or at least a skill requiring a minimum amount of experience with pictures (see Hochberg & Brooks, 1962; Dirks & Gibson, 1977; Rose, 1979). Cross cultural research, which originally supported the notion that picture perception

requires learning (Hudson, 1967; Duncan, 1962; Vernon, 1969), has recently indicated that children in pictureless environments can identify color photographs of familiar objects (Jahoda, Deregowski, Ampene & Williams, 1977; see Hagen & Jones, 1980 for a review). Even the early Gestaltists provided evidence that primates respond to photographs (Kohler, 1925); and more recent studies have supported their findings (Zimmerman & Hochberg, 1973; Kennedy, 1974) and have found that even lower animal forms are able to respond to pictures (Herrnstein & Loveland, 1964).

Despite this strong argument for picture perception as a natural ability, these studies have failed to demonstrate that the organisms were aware that they were responding to pictures. It is very possible that when very young children and animals respond to pictures, they are responding as if the pictures were real objects. For example, Kohler's ape responded to photographs of apes as if they were real apes; Nineo and Bruner (1978) have observed during a child's early experience with pictures that he occasionally grabbed for the objects depicted, and Kennedy (1974) has demonstrated that it is possible to be deceived by line drawings and contends that uneducated or very young children, when looking at pictures "...deal with the thing depicted, not the particular color, slant and unique viewpoint or design of the picture (p. 52)." At best, these data demonstrate the living organism's

ability to see a resemblance between a two dimensional and three dimensional stimulus, which is only a starting point for the investigation of picture perception.

Studies of learning and memory provide data that are compatible with the above interpretation. It has been found that very young children demonstrate good retention of pictures during the first year of life and become very efficient by the preschool years, comparable to adult performance, if processing demands are kept to a minimum in simple recognition tasks. However, age differences in performance become evident when pictures are used with more complex tasks, such as paired associate learning, recall tasks, and concept learning (see Rohwer, 1970; Levin, 1976; Reznick, 1977). Although a number of explanations can be used to account for these data, e.g., verbal mediation, it is at least evident that processing pictorial information involves a level beyond simple recognition.

Sigel, noting the research on learning and memory as well as his own work on the effects of symbolization on classification behavior proposes a theory of pictures based on the distinction between picture recognition, i.e., identifying the pictures contents, and picture comprehension (1978). Sigel describes picture comprehension as a constructive process in which an individual makes a judgment as to the possibility of a particular picture representing a

referent. Sigel notes that there are a number of transformations that occur when something is represented in a picture, e.g., the size is dramatically changed, there is a reduction from three-dimensional spatial arrangement to two-dimensions, and the perceiver of the picture must be aware of these transformations and yet establish equivalence between the meaning of the picture and what it represents. Picture comprehension thus involves coordinating the disparity between a picture and its referent with the similarity between the two and establishing equivalence. Sigel describes this process as the "conservation of meaning" in light of the pictorial transformations. Sigel's studies of classification skills reveal that very young children and low income children have difficulty classifying pictures of objects, but have no difficulty classifying the actual objects. This finding is used to suggest that these children do not comprehend the pictures as equivalent to the referent objects and consequently classify them differently.

Sigel's position is similar to the arguments of Gombrich, Snyder and Novitz reviewed earlier, in that picture comprehension involves an awareness of the characteristics of the pictorial medium, as well as knowledge of how pictures are used in the world and finally the establishment of equivalence between the two. However, an important distinction between Sigel's position and the latter positions concerns the ontogeny

of this ability to establish an equivalence. Unlike Gombrich, Snyder and Novitz who stress experience with the medium, Sigel contends that the conservation of meaning in pictures is achieved in a manner similar to the acquisition of general conservation abilities, as described by Piaget.

> The question, then, is what the developmental features of this acquisition are. Are the developmental requirements the same as those involved in the acquisition of other types of conservation (e.g., mass and/or weight)? Is it just familiarity? My contention is that the ability to comprehend pictorial stimuli emerges as the child acquires the principle of conservation of any quality (pp. 105-106).

In keeping with the Piagetian interpretation, the principles of conservation are acquired by actions on objects which result in rules by which the child can cope with diversity. Thus, "the conservation of meaning is an outcome of the child's interaction with the object world (p. 107)," suggesting that no specific experience with pictures is necessary for comprehension.

A recent series of studies by Beilin and his students support the above interpretations indicating that picture comprehension involves a level of complexity beyond the simple recognition of the content depicted and that children's understanding of the representational relationship between a picture and what it represents undergoes a series of changes with increasing age. Pearlman and Beilin (1979) investigated young children's (3-5 years) understanding of the physical

attributes of objects that can be represented in photographs. The children in this study viewed photographs that were either realistic in color and size, color only, size only, or in neither color nor size, and were questioned whether the functions and physical properties of the real objects could be attributed to their photographic representations, e.g., could this picture of an ice cream cone be cold. The results revealed that younger children demonstrate "iconic realism," i.e., attributing properties of the real objects to their photographic counterparts under all four conditions, while four-and five-year-olds make more appropriate responses. While these findings seem to suggest that three-year-olds see photographs as equivalent to reality, the data can also be explained as a result of the children's failure to understand the limitations of photographs. These children may be aware that the photograph is not the object, but due to their lack of knowledge about photography do not know exactly what attributes are captured in the photograph. At the same time there appears to be a tentativeness about their understanding indicated by the fact that only one child who thought the ice cream cone picture would be wet and cold asked if she could taste it. These observations suggest that young children are confused about the nature of the photographic representation rather than affirming their belief in the reality of photographs.

Kose, Beilin and O'Connor (1980) studied children's ability to comprehend action information depicted in photographs and use that information to direct their own actions. Children, ages three through six years, were shown black and white photographs of children performing various activities and were asked to imitate these actions. The children were also asked to imitate a model performing the same activities either before or after the presentation of the photographs. Finally, after both tasks were completed, the children were asked to provide verbal descriptions of the photographs. The results revealed that the three-and four-year-old children had difficulty imitating the actions depicted in the photographs, while the older children performed significantly better. All the children successfully imitated the model performing the same activities. Analysis of the verbal descriptions of the photographs indicate that the younger children were less likely to give active descriptions than the older children, instead they tended to list the characteristics depicted. To investigate whether these findings were unique to photographs, same age children were asked to imitate comparable actions depicted in line drawings and modeled by a doll. All the children imitated the doll with no difficulty, while the three-year-olds had some difficulty with the line drawings but performed better than when asked to imitate actions depicted in photographs. These

data suggest more clearly young children's failure to understand the equivalence between information presented in pictorial form and its referent, and further suggest that finer distinctions exist between varieties of visual presentations.

O'Connor, Beilin and Kose (1981) investigated six-year-old children's belief in the fidelity of photographs and its effects on problem solving. The children were distinguished as preoperational or concrete operational by their performance on a liquid conservation task and were then asked to compare an actual conservation task with a slide presentation of a conservation task. In one condition, the slide presentation resulted in an illogical ending, i.e., the water level in the taller thinner glass was equal in height to the water level in the standard glass; in another condition the actual conservation task resulted in an illogical outcome. The order of presenting either condition was counterbalanced with one group of children seeing the slide presentation first and another seeing the actual conservation task first. The children were asked to anticipate water-level and amount in the slide presentation and to make conservation judgements for the actual presentation. They were also asked to directly compare the final slide with the outcome of the actual task and indicate how the water really should look. The most significant findings revealed that concrete operational

children made more accurate comparisons than the pre-operational children, but also that all children were influenced by whichever conservation task (actual or slide presentation) they saw first. For example, a significant proportion of children would choose the photograph as correct when compared to an actual conservation task if the photographic slide presentation was seen before the actual task. This study was replicated with a series of line drawings of a conservation task and the results suggest drawings are not as compelling as the photographs. The children more consistently choose the actual conservation task over the drawings, even when the actual presentation resulted in an illogical outcome. These data indicate that children as old as six years have difficulty evaluating information presented in pictorial form, e.g., believing in the fidelity of inaccurate photographs when compared to an accurate referent, but further suggests, when compared with the two previous studies, a change in children's understanding of pictures. In both Pearlman and Beilin, and Kose et al., studies, there is evidence that children have difficulty responding to the representational nature of photographs, while in O'Connor et al., there is evidence that children may believe that photographs can faithfully represent reality but they do not fully comprehend the limits of that relationship and evaluate the information presented in photographs with particular regard to logical relationships or physical

reality.

Although these three studies support the notion that there is a distinction between mere picture recognition and the comprehension of pictures which involve more complex processes, it is important to point out that the children's difficulty with the various tasks is believed to be a result of the unique characteristics of photographs (Beilin, 1980), and not due entirely to the children's general inability to understand the nature of conservation, as Sigel would suggest. For example, in O'Connor et al., fidelity judgments were influenced by order of presentation for both preoperational and concrete operational children. If the acquisition of conservation is all that is necessary for pictorial comprehension then the concrete operational children should understand the subordinate relationship that photographs have to actual events and/or their knowledge of conservation. The data, however, indicate that concrete operational children maintain a belief in the fidelity of photographs independent of their perceptions of actual events or principles of conservation. Furthermore, the influence of the photographic presentation was not found when the study was repeated using line drawings. It may be that children's understanding of the representational relationship between photographs and reality is a function of their specific experience and knowledge of the photographic medium. Children as young as six years of age commonly find

photographs used to document actually occurring events. It is reasonable vis a vis the cultural practices surrounding photography to believe in the possible fidelity of photographs. While it is not as common for a six-year-old to have experienced art photographs or to be aware of the possible manipulation that can be performed by a photographer to alter the nature and quality of the photographs (Snyder & Allen, 1975). It is unlikely that a young child would question the truthfulness of a photograph. O'Connor (1980) has suggested that semiotic or symbolic functioning involves, in addition to signifying a meaningful referent, consideration of the physical knowledge of the medium in use. Physical knowledge of media consists of expectations about the type of attributes and functions that are characteristic of a particular medium; as in the case of photography, detailed, veridical communication of information is commonplace.

Concerns of the Present Study

The review thus far has indicated that a psychological account of picture perception seems to require consideration of the individual's knowledge and ability to think about pictorial forms, i.e., about the means of expression and the various functions of pictures, in order to understand how pictorial representation is to be interpreted. Empirical evidence while demonstrating that picture recognition is achieved early in life with little or no learning involved,

has also shown that young children have difficulty responding to pictures in more complex tasks. It was suggested by Sigel, in line with the above theoretical account, that the difficulty is due to the children not fully comprehending the meaning of pictures, which involves the perceiver establishing an equivalence between the picture and its referent despite obvious discrepancies. A second related issue was raised however, concerning the ontogeny of this ability to interpret the more complex levels of picture comprehension. It was proposed that the ability to comprehend the meaning of pictures rests on more general cognitive capacities, i.e., conservation skills, while other evidence suggested that such an ability is the result of specific experience with a particular medium.

The proposed study has two specific purposes. First, this study is designed to investigate children's ability to generate notions about a particular medium, photography, and to determine the extent to which children use these notions in comprehending the meaning of pictures beyond the level of simple recognition of content. Of particular interest is the point at which children begin to incorporate these notions about the means and function of expression into their interpretation of a photograph. Secondly, this study will examine the influence of general cognitive abilities and specific experience with the medium of photography on the children's

generation and use of these notions about photography.

Children ages six through twelve years were selected from schools which have as part of their curriculum photography programs which involve the children taking photographs on a regular basis and in some cases provide technical instructions on the processing of film. In addition to age, children were distinguished by cognitive level, as measured by Piagetian tasks. Matching groups of children (with regard to age and cognitive level) were selected who have had no special experience with photography.

The children's ideas and thoughts on photography were assessed by two measures. First, the children were engaged in an open-ended interview. There was a general format of questions directing the course of the interview. The second measure involved asking children to respond to a series of individual photographs. A general format of questions was also used to initiate the children's responses.

The data from this study inform three areas of interest. The interview and the children's responses to the photographs provide descriptive data concerning children's notions about photography, such as when children begin to conceive of photographs as intentional creations, when they become aware of the possibility of the manipulation of photographic techniques to create an effect and what possible

functions a photograph could serve. Of particular interest is the degree to which the children's thinking about photography show consistent patterns across age, cognitive level and their degree of experience with photography, and if developmental shifts occur. It is expected that children's thinking about photography will similarily reveal distinct characteristics that will undergo developmental changes in their nature and complexity. This expectation is due, not only to the general developmental shifts that occur in the nature of thought as described by Piaget, but also because of the uniqueness of the domain of photography and the fact that comprehension of this domain may require a number of levels of complexity.

The second area of interest concerns the dimensions of the children's thinking about photography. This area is informed by a comparison of the two measures used, the interview and the responses to the photographs. It may be that children's thinking about photography is a unitary construct and would determine performance on both measures. It may be argued however, that the interview data are merely a demonstration of children's ability to formulate creative explanations for unfamiliar phenomenon, or a more intermediate position may exist where abstract conceptualization is inadequate to

explain actual responses to specific photographs. Gardner, in studies of artistic sensitivity, found that young children are often precocious in performance, but lag behind when expressing explicit conceptualizations of their performance (1973; 1974; Winner, Rosetiel & Gardner, 1976). No predictions are made with regard to the nature of the relationship between these measures.

Finally, the data from this study will yield information on the influence of age, cognitive ability and specific experience with photography on children's thinking about photography and their responses to photographs. In line with Sigel's position, studies that have looked at children's conceptions of the arts suggest a relationship between cognitive ability or stage, and the sophistication of the children's responses (Baldwin, 1915; Ecker, 1973; Gardner, Winner & Kircher, 1973). However, this relationship has never actually been tested. Gardner et al., for example, interviewed children ages 4-5, 7-8 and 16 years, on their conception of art, but no measures of cognitive ability were used. Their results revealed qualitatively different views about art ranging from legalistic and mentalistic notions for younger subjects, through realistic interpretations for the middle age range, to relativistic concepts of artistic productions for adolescent subjects. It was

concluded that the children's conceptions of the arts mirrors the changes described by cognitive developmental theorists.

The authors did qualify their conclusion by mentioning that within the arts, diverse media are involved that may involve their own traits and structure; also children have very little direct experience with the arts, and their comprehension of the arts may be influenced by mass technology and social factors. It may be reasonable to distinguish studies of various art forms from other areas of learning and cognition. It would seem that these qualifications were not revealed in their study due to the general nature of their interview concerning art, and by not controlling for cognitive level and experience. The present study, focusing on children's knowledge of photography and controlling cognitive level and experience, is more suited to examine these issues.

With regard to the effects of cognitive ability and specific learning on responses to specific pictures, research findings are inconclusive. Machotka (1966) studied children's (age 6-18 years) preferences for a wide range of paintings. Analysis of the reasons children gave for their choices revealed the youngest subjects tend to base preferences on colors; subjects in the middle years

refer to realism and only adolescents cite style, composition and affect. Machotka concludes that these reasons reflect Piagetian stages of preoperations, concrete operations and formal operations, respectively. Gardner (1972) studied concrete operational children's ability to sort paintings by style, which according to Machotka is an ability that does not develop until formal operations have been established. Gardner found that the subjects initially tended to sort according to subject matter, but could also be trained to sort paintings by their stylistic qualities; and thus that sensitivity to artistic style is not dependent on operational level but rather seems to involve the ability to detect recurrent textures across a variety of paintings. Gardner's training procedure involved seven weeks of exposure to similar sorting tasks, although different paintings were used; in which the experimenter demonstrated and verbally reinforced grouping the paintings by style. Although these findings suggest that experience with the medium, and not cognitive level influence children making more sophisticated responses, it could be argued that such a direct method of training could have produced spurious changes in performance. The present study examines a more natural form of medium specific experience, in which children were

not instructed in aesthetics or in how to interpret stylistic qualities, but rather in the technique of creation and examines the effects of this activity on the comprehension and interpretations of photographs. Provided the theoretical orientation of this study, it was expected that although age and cognitive level may correspond to changes in children's thinking about photography and their responses to photography, specific experience with the photographic medium would be most important in determining the nature of their thinking and the rate of change.

In sum, an adequate psychological account of picture perception and the nature of pictorial representation requires consideration of the perceiver's knowledge and ability to think about means of expression and the functions of pictures. This study was an attempt to examine the development and characteristics of this level of pictorial interpretation and the changes that may occur with age, cognitive level or specific experience with the medium of expression. Children of approximately the same ages at differing cognitive levels were selected on the basis of their experience with photography. The children were interviewed with regard to their understanding of photography and asked to respond to a series of photographs by discussing their interpretations.

METHOD

Subjects

The subjects for this study were 148 middle-class children of mixed ethnic and racial backgrounds. The children attended private elementary schools in the New York metropolitan area. The children were drawn from either a second-or sixth-grade class. The children from the second grade classroom ranged in age from 7 years 4 months to 8 years 3 months, $\bar{X}$ = 7;10, and the children from the sixth-grade classroom ranged in age from 11 years 6 months to 12 years 3 months, $\bar{X}$ = 11;11. All of the children were pretested to determine their level of cognitive ability using Piagetian measures. It was necessary to pretest this number of children to obtain 24 seven-year-olds who were classified as pre-operational; 24 seven-year-olds who were classified concrete operational; 24 eleven-year-olds classified as late concrete operational; and 24 eleven-year-olds classified as formal operational. The remaining 52 children were classified as transitional between two of the cognitive levels, or their assigned group was already filled and were not used in the study.

Twelve of the children at each of the four cognitive levels were chosen on the basis of their participation in a photography course provided as a school elective. The remaining twelve children at each of the four cognitive levels were chosen from among those children who did not

participate in such a course.

Piagetian measures of operational level

The seven-to eight-year-old children were distinguished as either preoperational or concrete operational based on their performances on two Piagetian tasks. The first was a conservation of liquid quanities task, and was administered following the procedure outlined by Piaget (1965). The second task involved solving a class inclusion problem following the procedure outlined by Inhelder and Piaget (1964).

The eleven-to twelve-year-old children were also distinguished as either late concrete operational or formal operational by their performance on two Piagetian tasks. Due to the difficulty in replicating Inhelder and Piaget's (1958) original studies of formal operational thought (Lovell, 1961; Berzonsky, 1971), indirect measures of formal reasoning were used.

First, the eleven-to twelve-year-old age group were given conservation of volume task according to the procedure described by Piaget and Inhelder (1974). This task has been discussed as the most difficult form of conservation task, that is usually solved by preadolescent children just prior to the onset of formal operational thought. The second task involves combinatorial reasoning in which the children were asked to predict the most probable outcome before randomly drawing pairs of counters from a large collection. The

procedure follows that described by Piaget and Inhelder (1975) who discuss the ability to solve this problem as a characteristic of formal operational thought.

The six-to seven-year-old children who participated in this study were classified as concrete operational if they successfully completed both the conservation of liquid quantities task, and the class inclusion task. Children who passed only one of the tasks or fluctuated in their answers were considered transitional and were not used in the study. Similarly among the eleven-to twelve-year-old children, those who passed both the conservation of volume and probability tasks were classified as formal operational. Those who failed both tasks were administered the conservation of liquid quantities and class inclusion tasks, and if both were passed, these children were classified as concrete operational. Transitional children, passing one of the tasks or fluctuating in their answers were not used.

School photography course

Half of the subjects selected to participate in this study were from among children who have taken an elective photography course at school in either the last semester or were presently involved in one. The photography courses in the various schools characteristically emphasized the taking of photographs and developing film. The children in these courses were provided with a camera and film, and were

encouraged to take photographs on their own time at their discretion. Occasionally specific assignments were given in which the children had to take photographs of particular themes. The majority of the class time was spent instructing the children in the developing process. The children were not instructed to the aesthetics of photography or criticism, and they did not view the works of professional or art photographers. The children did see the work of other children and were sometimes engaged in informal discussions about the works.

The remaining half of the children were chosen from among children who did not participate in the photography course. To ensure a limited amount of photographic experience of this group, a brief questionnaire was sent to all the children's parents, attached to the permission request forms, inquiring about the parents involvement with photography. The parents were asked if they were involved with photography at any professional level; if they owned a 35 mm camera and a system of lenses; if they had a dark room at home and if they ever instructed their child in photographic technique. Any child who did not participate in their school's photography course, but had received instructions or experience with photography at home, was not used in the study. Of the parents who had the most involvement with photography, their children tended to enroll in the photography course at school.

Materials

Conservation of liquid quantities task

In this task, three glasses were used. Two glasses were identical, 3 inches high and 2½ inches wide, and served as the standards. The third glass was 6 inches high and 1½ inches wide. The water in the glasses contained red food coloring to facilitate the perception of the water level.

Class inclusion task

Two sets of objects were used in the class inclusion task. Thirteen toy animals, 5 dogs and 8 cats served as the first. Twenty shapes, 8 red squares and twelve blue circles served as the second set.

Conservation of volume task

Two large 8 ounce glasses, 5½ inches high and two balls of clay, approximately 1 inch in diameter were used in this task. The water in the glasses contained red coloring to facilitate perception of the water levels.

Random drawing of pairs task

In this task, a large collection of plastic counters were used: thirty yellow, twenty red, fourteen green and six blue.

Procedure

Each child in this study was seen on two separate days,

no more than a week apart. On the first day, the children were given the Piagetian tasks to determine their cognitive level. On the second day, the children were interviewed about the nature of photography and asked to respond to the eight photographs.

Conservation of liquid quantities

In this task, the child was first presented with two standard glasses and a pitcher of water. The child was asked to pour water into each of the glasses so that there was the same amount of water in each glass. Once the child established equivalence between the two standard glasses, the experimenter then brought out the tall thin glass and transfered the water from one of the standard glasses to the tall thin glass. The child was then asked the conservation question comparing the amount of water in the standard glass with the amount of water in the tall thin glass.

Class inclusion task

In this task, the child was presented with one set of objects, e.g., the animals, and asked to identify the class of objects and in subclasses. Having correctly identified the class of objects and the proportions of its subclasses, the child was asked the class inclusion question comparing a subclass of the objects with the entire class. This procedure was repeated with the second set of objects.

Conservation of volume task

In this task, the child was presented two glasses with equal amounts of water in each glass. The child was given two identical clay balls and was asked to predict what would happen if he or she dropped a ball in each of the glasses. Following the prediction, the child was instructed to do so and note the result. One clay ball was then removed from one of the glasses and the child was asked to transform the ball into a different shape (either a hotdog or pancake shape). The child was then asked to predict the outcome of dropping the transformed clay back into the glass.

Probability task

In this task, the child was asked to predict a possible outcome of a random drawing from a collection of various counters. A collection of counters, 15y, 10r, 4g and 3b were placed on a table in front of the child. A duplicate set of counters was placed in a bag and mixed. The child was then instructed to put his hand in the bag and bring out a pair of counters. Just before reaching for the counters, the child was asked to predict the most probable pair. When a pair was drawn, it was placed on the table in front of him so he could remember what counters are left in the bag. This procedure was repeated for ten draws. Following children's predictions, they were asked why they made their predictions.

Successful completion of this task required that the child quantify the possibilities after each drawing.

Procedure

Interview

Each child was individually interviewed by a male experimenter. Both the interview and the children's responses to the photographs were recorded and later transcribed for analysis. Children were brought to a quiet room and given a brief explanation about the tape recorder. The children were then told that the experimenter was interested in finding out the way people understand and look at photographs and that he was going to ask the child some questions about photographs and would like to know what the child thought.

The general format of questions asked during the interview was as follows: 1. What is a camera? 2. When do people use cameras? 3. Are there things you can't take photographs of? (The word picture was substituted if the child was confused by the word photograph.) 4. Are there good things to take photographs of? 5. Are there special things to take photographs of? 6. What makes a photograph good? 7. What makes a photograph bad? 8. Does a camera always make things look the way they really look? 9. Can there be photographs of things that are not real? 10. Can there be photographs of things that happened a long time ago?

11. Can there be photographs of things that haven't happened yet? The questioning was conducted in an informal manner so that additional questions were asked for the purpose of clarification and elaboration.

Presentation of the Photographs

Immediately following the interview, the children were shown a series of eight photographs, individually presented in random order, and were asked to respond to a number of questions about each photograph. The children were told that they were going to be shown some photographs, and that the experimenter was interested in what they thought about them.

The questions asked about each of the eight photographs were as follows: 1. What is this? 2. Is this real? 3. How do you think this was made? 4. Why do you think someone made this? 5. Do you think this is good, bad, silly or funny? 6. Is there any way this could be made better? As with the interview, the questioning was informal to encourage the children to clarify and elaborate their responses.

The eight photographs shown to the children were chosen from four photographic styles. The four styles are described in Newhall's (1964) History of Photography. The four styles are documentary, straight photography, formalistic and metaphoric. Each style functions in different

ways by making use of the various qualities unique to photography. Documentary photography's primary function is to communicate information about reality. The subject represented in the photograph is of primary importance. Efforts are made to produce a clear, honest and convincing print, and to play down signs of photographic manipulations. Early travel photographs and portraits, which were the first form of photography, functioned in this documentary fashion.

Straight photography begins to explore the aesthetics of the photographic medium. Photographers who work in this style make use of the camera's ability to record exact images with rich texture and detail. In straight photographs, as in documentary photographs, the subject is and can be clearly distinguished, but the added exactitude of the photographic medium creates a new, somewhat detached, experience. This style of photography is clearly representing reality as does the documentary photograph, but differs in that the photographer and the medium itself is made obvious by the exact clarity of the print. In the documentary photograph, reality is re-presented, while in straight photography, reality is being interpreted by the photographer by way of the photographic medium.

The formalistic style of photography goes a step further than straight photography in stressing the photographic medium. The subject or content of the photograph

is of no concern to the photographer and is often difficult to distinguish. The primary function of the formalistic photograph is to exploit certain phenomena of the photographic process, such as manipulating the tonal scale of a print, edge reversal of the image and the use of the negative as a final print. The abstract form and space relationships made possible through the photographic medium are considered the final product.

The metaphoric style of photography stresses the metaphoric aspects of a photograph. Both subject and photographic technique are put aside to underscore the ideas motivating the photographer. Photographs created in this style function symbolically by representing the creators conceptions by making use of cultural and historical knowledge in expressing meaning; as discussed by semioticians such as Barthes (1977). The photographs selected from these four styles are listed by title and photographer in Table 1.

TABLE 1

Photographs Grouped by Style[a]

Documentary Photographs
Explosion of the Hindenburg, Shere, 1937.
Canyon de Chelly, O'Sullivan, 1873.
Straight Photographs
Town Hall, Strand, 1946.
Mono Lake, Adams, 1947.
Formalistic Photographs
The Octopus, Coburn, 1912.
Swirls and eddies of a tennis stroke, Edgerton, 1939.
Symbolic Photographs
The Kiss of Peace, Cameron, 1867.
Child in Forest, Bullock, 1951.

[a]These photographs are black and white prints taken from Newhall's The History of Photography, 1978.

RESULTS

Data Analysis

The individual protocols from the interview and from the children's responses to the photographs were coded without information about the child's age, cognitive level or experience with photography. The responses to the interview questions and the questions asked about the photographs were coded into a variety of categories, each representing the concern or considerations expressed by the child. These categories were derived empirically from an initial examination of the protocols. Four general categories were identified across all questions. The first general category of response expressed consideration of the subject or depicted content of a photograph; the second category represented responses concerned only with the characteristics of the photographic medium; responses in the third category represent comments about both the depicted content and medium characteristics; and the fourth category involves responses concerned with the subjective intentions of the photographer.

The protocols from the interview questions were further distinguished into seven sub-categories which better illustrate the nature of the children's responses. Brief descriptions of these seven categories are as follows:

1. Content Considerations

   (a) Content limitations:

   responses in this category distinguish specific content items or events that are suitable to be photographed, as well as items and events that cannot be photographed. An example of this kind of response is, "You can't take pictures of chairs and things in a museum." , or, "Dogs and people are good for that (referring to taking a photograph)."

   (b) Content without limitations:

   the individuals giving this type of response mention content items and events in discussing photography but do not qualify their concerns with any limitations, for example, "No, you can take a picture of anything you want, like a person or car or flower or anything."

2. Medium Considerations

   (a) Medium limitations:

   responses in this category mention certain characteristics of the photographic medium such as lighting, distance and focus that must be considered when creating a photographic print. An example of this kind of response is, "Sometimes camera's make things dark or fuzzy and you can't see them."

(b) Medium without limitations:
responses in this category mention the medium but attempt to specify equipment necessary to achieve certain ends. The children who express this type of response often mention the need for special lens, film or tripods, for example, "You can make any kind of picture, but if you want something small to look big, you need a lens that will do that."

3. Content and Medium Considerations

(a) Depicted content limiting medium:
in this category, responses express a concern that certain items and events cannot be photographed because their characteristics are not suited to the requirements of the photographic medium. An example of this type of response is, "You can't take a picture of the sun because there is too much light for the camera."

(b) Content and Medium without limitations:
these responses also discuss the interaction of the contents' characteristics and the requirements of the photographic medium; however, this type of response is distinguished from the previous type of response in that no limitations are mentioned. Considerations of content and medium interact

reciprocally in the production of a photographic print, for example, "You could take a picture of a light bulb if you have a fast shutter speed."

4. Photographer's Intentions

Responses in this category reveal a primary concern with the motivation of the person taking the photograph. No mention is made of either content or medium characteristics. An example of this type of response is, "I don't know, it depends on who took it, it might not turn out the way he wanted it."

The children's responses to the presentation of the photographs were coded into three categories. Brief descriptions of the categories are as follows:

1. Content Considerations

The children's responses in this category are concerned with the content depicted in the various photographs. There is no mention of the characteristics of the photographic medium or the process of taking the photograph.

2. Medium Considerations

These responses only mention the characteristics of the photographic medium, for example, the clarity, size, color or lighting of the various photographs.

3. Content and Medium Considerations

   Responses in this category discuss the interaction of the characteristics of the depicted content with the characteristics of the photographic equipment. Mentioning station point, distance and movement relative to the content are common aspects of this type of response.

Although the children mentioned the intentions of the photographer in their responses, they always included reference to the photographer's interest in the content or use of the medium or a combination of both. Thus, responses that considered the intentions of the photographer are not distinguished and were coded in one of the three categories described above.

A mean summary score was computed for each category based on the children's responses to all nine questions in the interview and from the six questions asked during the presentation of each photograph. Thus, each child has seven summary scores representing his or her responses to the interview and three scores for the presentation of each photograph. Each summary score ranges between 0 and 1. The summary scores from the interview were analyzed separately from the summary scores from the presentation of the photographs.

Interrater Reliabilities

Interrater reliability was obtained for a subsample of forty-eight randomly chosen protocols for the summary scores for all categories. The reliability coefficients are presented in Table 2 for the seven categories for the interview data, and in Tables 7 and 8 for the three categories for the data from the presentation of the photographs. The interrater reliability coefficients were high, greater than .70 for all categories.

The Interview

The mean summary scores for the seven response categories from the interview data are presented in Table 2 by age. A two way repeated measures analysis of variance (Age by Response Category) revealed no significant main effect for age, $F(1,93) = 1.085$, $p > .05$; a significant main effect for response category, $F(7,64) = 8.483$, $p < .001$; and a significant age by response category interaction, $F(7,64) = 18.94$, $p < .001$. Scheffe post hoc comparisons were computed to determine the specific nature of these effects.

The eight-year-old children had significantly higher scores in the Content limitations and Medium limitations categories than in any other category ($p < .05$). These scores were also significantly higher than the twelve-year-olds' scores in these categories ($p < .05$).

Table 2

Response Categories to the Interview Question: Interrater Reliability Coefficients & Mean Summary Scores By Age[a]

Category	Reliability Coefficient	Mean By Age 8	12
Content limitations	.96	0.30	0.08
Content without limitations	.90	0.16	0.06
Medium limitations	.97	0.24	0.16
Medium without limitations	.94	0.10	0.04
Depicted content limiting medium	.82	0.06	0.36
Content and medium without limitations	.86	0.08	0.25
Photographer's intentions	.97	0.06	0.04

[a] N = 96

The twelve-year-old children had the highest summary scores in the Depicted content limiting medium, and the Content and medium without limitations categories ($p < .05$). Both of these scores were significantly higher than the eight-year-olds' scores in these categories ($p < .05$). From this analysis, the eight-year-old children showed the strongest tendency to discuss either the content depicted in the photographs, or the limitations of the photographic medium, while the twelve-year-old children showed a stronger tendency to discuss the interaction of depicted content with the characteristics of the photographic medium.

In order to investigate the effects of cognitive level and experience with photography on the children's responses, separate analyses were performed on the eight- and twelve-year-olds' scores. A three way repeated measures analysis of variance (Cognitive Level by Experience by Response Category) computed on the eight-year-olds' scores revealed no significant main effects for cognitive level, $F(1,44) = 100$, $p > .05$, or experience with photography, $F(1,44) = 1.05$, $p > .05$. There was a main effect for response category, $F(7,308) = 16.23$, $p < .001$, and a significant experience by response category interaction.

The mean scores for the eight-year-olds' are presented in Table 3 by experience and response category. Scheffe post hoc comparisons revealed that the children without

photography experience scored significantly higher in the Content limitations category than in any other category ($p < .05$). These children also had significantly higher scores in the Medium limitations category than in any of the remaining five categories. The children's scores in both of these categories were significantly higher than the scores of the children who had experience with photography ($p < .01$).

The eight-year-old children with photography experience scored significantly higher in the Medium limitations category than in any other category ($p < .01$). Their scores in this category were also significantly higher than the scores for the children without photography experience ($p < .05$). It appears from this analysis that the eight-year-olds' responses to the interview questions were not influenced by differences in cognitive level, but are affected by having experience with photography. The children without photography experience tended to discuss either content or medium characteristics, but did not mention any limitations inherent in the photographic technology, while experience with photography increased the eight-year-olds awareness of the limitations of the photographic medium.

The analysis of the twelve-year-olds' scores revealed no significant main effect for cognitive level, $F(1,44) = .340$, $p > .05$, or for experience, $F(1,44) = .450$, $p > .05$.

Table 3

Eight-year-olds' Scores for the Interview Presented by Experience and Response Category[a]

	Experience	
Category	No Photo Experience	Photo Experience
Content limitations	0.41	0.19
Content without limitations	0.14	0.19
Medium limitations	0.12	0.36
Medium without limitations	0.20	0.00
Depicted content limiting medium	0.04	0.08
Content and medium without limitations	0.01	0.14
Photographer's intentions	0.08	0.04

a N = 48

There was a significant main effect for response category, $F(7,308) = 16.87$, $p < .01$, a significant cognitive level by experience interaction, $F(1,44) = 4.162$, $p < .05$, a cognitive level by response category interaction, $F(7,308) = 13.498$, $p < .001$, a significant experience by response category interaction, $F(7,308) = 6.487$, $p < .001$ and a significant three way interaction, cognitive level by experience by response category, $F(7,308) = 5.677$, $p < .001$.

Mean scores are presented in Table 4 by cognitive level and response category. Post hoc comparisons revealed that the late concrete operational children scored significantly higher in the Medium limitations category than in any other category ($p < .05$). The formal operational children scored significantly higher in both the Depicted content limiting medium and Content and medium without limitations categories than in any other categories ($p < .05$).

The mean scores for late concrete operational children are presented in Table 5 by experience and response category. Post hoc comparisons revealed that children without photography experience gave a variety of responses, while the children with photography experience scored significantly higher in the Medium limitations category ($p < .01$) than they did in any other category and higher than the children with no photography experience did in that category ($p < .01$). The mean scores

Table 4

Twelve-year-olds' Scores for the Interview Presented by Cognitive Level and Response Category[a]

Category	Cognitive Level: Late Concrete Operational	Cognitive Level: Formal Operational
Content limitations	0.10	0.06
Content without limitations	0.10	0.02
Medium limitations	0.29	0.04
Medium without limitations	0.08	0.00
Depicted content limiting medium	0.14	0.58
Content and medium without limitations	0.20	0.30
Photographer's intentions	0.08	0.00

[a] N = 48

Table 5

Twelve-year-old Late Concrete Operational Children's Scores for the Interview Presented by Experience and Response Category[a]

Category	Experience	
	No Photo Experience	Photo Experience
Content limitations	0.16	0.04
Content without limitations	0.16	0.04
Medium limitations	0.08	0.50
Medium without limitations	0.16	0.09
Depicted content limiting medium	0.10	0.08
Content and medium without limitations	0.22	0.08
Photographer's intentions	0.10	0.16

[a] N = 24

for the formal operational children are presented in Table 6 by experience and response category. Post hoc comparisons revealed that formal operational children with photography experience score significantly higher in the Depicted content limiting medium category than the formal operational children without photography experience ($p < .01$).

The results of this analysis indicate that the twelve-year-olds' responses were influenced by both cognitive level and experience with photography, unlike the eight-year-old children who were only affected by the latter of these two variables. The late concrete operational children tended to discuss limitations of the photographic medium, while the formal operational children discussed the interaction of depicted content with the characteristics of the photographic medium

The effects of experience increased the children's awareness of the limitations of the photographic medium, as it did for the eight-year-old children. However, awareness of these limitations were seen in the various responses, appropriate to the different cognitive levels. The late concrete operational children with photography experience gave a variety of responses and were more likely to discuss the depicted content or the medium without mentioning limitations. Those with photography experience showed the strongest tendency to discuss either medium limitations, or how the content limits the possibilities of the medium. While

Table 6

Twelve-year-old Formal Operational Children's Scores for the Interview Presented by Experience and Response Category[a]

Category	Experience: No Photo Experience	Experience: Photo Experience
Content limitations	0.08	0.04
Content without limitations	0.04	0.00
Medium limitations	0.08	0.00
Medium without limitations	0.00	0.00
Depicted content limiting medium	0.45	0.71
Content and medium without limitations	0.35	0.25
Photographer's intentions	0.00	0.00

[a] N = 24

all the formal operational children discussed the interaction of content and medium, those with photography experience were specifically concerned with the ways in which the content limits what can be expressed in the photographic medium.

Analysis of the interview data suggests certain characteristics of children's thinking about photography. In responding to the interview questions, it was found that both eight-and twelve-year -old children will discuss both the depicted content of photographs as well as the characteristics of the photographic medium itself. This finding is contrary to the findings of others who describe children in middle childhood being primarily concerned with the information depicted in pictorial forms and only gradually becoming aware of the representational medium during early adolescence (Machotka, 1966; Gardner, Winner & Kircher, 1971; Gardner, 1972; Kennedy, 1974; Carothers & Gardner, 1979; Ecker, 1973). The discrepancy between these findings could be due to methodological differences. The extensive nature of the interview in this study facilitated the children's discussion of the representational medium. While the younger children had a tendency to discuss depicted content, as others have described, they did discuss the representational medium when encouraged to do so.

Another reason for the discrepancy between these findings and those of earlier studies may be the nature of the photographic medium itself. In these earlier studies, children responded to paintings or drawings or were asked to discuss art in general, photography provides a rich array of distinct technological equipment that can be identified and integrated into the children's responses.

A second characteristic revealed by these data concerns the nature of change in children's thinking about photography. Unlike earlier studies describing a shift in the children's concern with content to concerns about the style of the medium, these findings indicated a change in the relational form of the children's thoughts. While both eight-and twelve-year-old children discussed the depicted content and the characteristics of the medium, the younger children discussed the content and/or medium in isolation from one another, while the older children discussed the interaction of both.

Thirdly, this change in the form of thought about photography is associated primarily with the change in operational level among the twelve-year-old children. Cognitive level did not influence the responses of the eight-year-old children, and experience with photography, while heightening the children's awareness of the limitations of the photographic medium at both age levels, did not

increase the children's tendency to discuss the interaction of content and medium.

Sigel (1978) has argued that the ability to integrate the identity of the depicted content with the discrepancies (i.e., differences in size, shape, color) caused by the pictorial medium in comprehending the meaning of a picture is a function of children's general ability to conserve and the development of logical thought. Given the distinction between the preoperational and concrete operational eight-year-olds (the latter have completed a conservation of liquid quantities task and a class inclusion task), it is reasonable to expect concrete operational children to discuss the interaction of content and medium. According to Piaget (1976), the abilities of concrete operational children presuppose the establishment of logical groupings which enable them to perceive discrete elements or characteristics as a coherent whole. The fact that the discussion of the interaction of content and medium is the dominant response only among the formal operational twelve-year-olds raises a question about the relationship of the nature of thought and the subject matter thought about, in this case, photography.

Although Piaget has demonstrated the emergence of logical thought during the period of concrete operations, he also points out that this logic is far from a formal system applicable to a variety of objects and ideas. The logic

of concrete operations is "...still relative to types of concrete ideas that they have actually structured, but the structuring of other types of concrete ideas, which are of a more intuitive nature, since they depend on quite different actions, requires a reconstruction of the same groupings independently of time (1976, p. 146)." Between the ages of 7-8 and 11-12 years, there is a time lag or decalage between the application of logical groupings to different domains of thought, e.g., as can be seen in the acquisition of the ability to conserve number, weight and volume. According to Piaget, the reason for this time lag is the "intuitive character of the substance" which facilitates or hinders the application of operational thought. The present study is directly concerned with the way the "intuitive character of the substance" influences the nature of thought; therefore, it is important to consider why the integration of content and medium in discussions about photography only occurred among the twelve-year-olds who have demonstrated some ability to perform formal reasoning tasks.

Two possibilities can be considered. First, the time lag in developing this sophistication in discussing photography may be due to the methodology used in the study. The interview required the children to provide verbal responses in an abstract form about the nature of photography. No actual photographs were used to aid the children in responding. Piaget

has indicated the necessity for concrete items in thinking during middle childhood, in that the logic of concrete operations are still tied to particular substances. The verbalization of a topic, that can normally be comprehended in concrete form, forces concrete operational children to deal at the level of formal propositions and make thought about that topic more difficult. Thus, the concrete operational children may have been capable of integrating content and medium in thinking about photography, but this was not apparent because of the verbal nature of the interview.

The second possibility involves the nature of photography itself as a domain of knowledge that requires more formal characteristics of thought than are available to eight-year-old concrete operational children. Consideration of this possibility requires further examination of children's thinking about photography in more varied situations than was provided in the interview to identify the formal characteristics. Both possibilities can be explored in the analysis of the children's responses to the photographs. These data provide a means of examining the children's responses to specific photographs as well as providing a variety of types of photographs to respond to.

Presentation of the Photographs

As previously described, following the interview, each child was presented eight photographs and were asked six

questions about each photograph. The children's responses to each question were coded into one of three categories and summary scores were computed for each category.

The mean scores for the eight-and twelve-year-old children are presented in Tables 7 and 8 by type of photograph and response category. A three-way repeated measures analysis of variance (Age by Type of Photograph by Response Category) was computed on these scores. There was no main effect for age, $F\ (1,92) = .042$, $p > .05$, or for type of photograph, $F\ (3,276) = .198$, $p > .05$. There was a main effect for response category, $F\ (2,184) = 28.99$, $p < .001$, a significant age by response category interaction, $F\ (2,184) = 8.34$, $p < .001$, and a type of photograph by response category interaction, $F\ (6,552) = 5.62$, $p < .001$.

Post hoc comparisons revealed that both eight-and twelve-year-old children score higher in the Content category than in any other category ($p < .01$). The eight-year-old children showed this tendency across all four category types, while the twelve-year-old children discussed content significantly more when responding to documentary or straight photographs ($p < .05$). When discussing either formal or metaphoric photographs, the twelve-year-olds' scores were equivalent across all three categories.

Table 7

Eight-year olds' Scores and Reliability Coefficients From the Presentation of the Photographs Presented by Response Category and Type of Photograph[a]

Category	Reliability Coefficient	Type of Photograph			
		Documentary	Straight	Formal	Metaphoric
Content	.97	0.55	0.55	0.41	0.46
Medium	.98	0.21	0.22	0.30	0.26
Content & Medium	.92	0.23	0.21	0.28	0.26

a N = 48

Table 8

Twelve-year-olds' Scores and Reliability Coefficients From the Presentation of the Photographs Presented by Response Category and Type of Photograph[a]

		Type of Photograph			
Category	Reliability Coefficient	Documentary	Straight	Formal	Metaphoric
Content	.97	0.44	0.41	0.28	0.38
Medium	.95	0.27	0.29	0.35	0.31
Content & Medium	.88	0.26	0.29	0.35	0.30

a N = 48

In order to examine the effects of cognitive level and experience with photography on the children's responses, separate four-way repeated measures analysis of variance were performed on the summary scores for the eight-year-old children and the twelve-year-old children.

From the analysis of the eight-year-olds' scores, there were no main effects for cognitive level, $F(1,44) = 1.35$, $p > .05$, experience with photography, $F(1,44) = 1.48$, $p > .05$, or type of photograph, $F(1,132) = 1.69$, $p > .05$. There was a main effect for response category, $F(2,88) = 32.48$, $p < .001$, and a significant interaction between type of photograph and reaponse category, $F(6,264) = 3.395$, $p < .005$. The summary scores can be seen in Table 7, and have already been described in the discussion of the age analysis. Thus, the eight-year-old children tended to make reference to the depicted content of the photographs regardless of the type of photograph presented. Cognitive level and experience with photography did not influence their responses.

The analysis of the twelve-year-olds' summary scores revealed no significant main effects for cognitive level, $F(1,44) = .294$, $p > .05$, experience with photography,

$F(1,44) = 3.97$, $p > .05$, and type of photograph, $F(3,732) = .592$, $p > .05$. There was a significant main effect for response category, $F(2.88) = 3.42$, $p < .05$, and a number of significant interactions: type of photograph by response category, $F(6,264) = 2.759$, $p < .05$, cognitive level by type of photograph by response category, $F(6,264) = 4.23$, $p < .001$, and cognitive level by experience with photography by type of photograph by response category, $F(6,264) = 2.546$, $p < .05$.

Post hoc comparisons revealed that the twelve-year-old children, like the eight-year-olds, score significantly higher in the content category than in any other category. The summary scores can be seen in Table 8, and the type of photography by response category interactions have already been described in the discussion of the age analysis, in which the children tended to give content responses to documentary and straight photographs, and have equivalent scores when discussing formal or metaphoric photographs.

Unlike the eight-year-old children, however, cognitive level and experience with photography influenced the twelve-year-olds' responses. With regard to the effect of cognitive level, the summary scores for the late concrete operational children are presented in Table 9. These children scored significantly higher in the content category and the medium category when presented the documentary, formal and metaphoric

photographs ($p < .05$). When presented with the straight photographs, they tended to discuss only the depicted content ($p < .05$). They do not discuss the interaction of content and medium. The summary scores for the formal operational children are presented in Table 10. These children scored significantly higher in the content category for the documentary photographs ($p < .01$), their responses to straight photographs were equivalent across categories, when presented with formal photographs, they scored significantly higher in the content and medium category ($p < .05$), and when presented the metaphoric photographs, they showed the strongest tendency to discuss either the depicted content or the interaction of content and medium ($p < .05$). The late concrete operational children tended to discuss either content or medium characteristics, while the formal operational children discussed the interaction of content and medium. In addition, however, this analysis has shown that the formal operational children were more varied in their discussion of the photographs, showing different concerns for the various types of photographs.

Experience with photography also interacted with cognitive level affecting the children's responses to the various photographs. The summary scores for the late concrete operational children without photography experience and with photography experience are

Table 9

Late Concrete Operational Children's Summary Scores From the Presentation of the Photographs Presented by Type of Photograph and Response Category[a]

Response Category	Type of Photograph			
	Documentary	Straight	Formal	Metaphoric
Content	0.35	0.47	0.36	0.37
Medium	0.37	0.26	0.36	0.36
Content & Medium	0.28	0.26	0.28	0.26

a N = 24

Table 10

Formal Operational Children's Summary Scores From the Presentation of Photographs Presented by Type of Photograph and Response Category[a]

Response Category	Type of Photograph			
	Documentary	Straight	Formal	Metaphoric
Content	0.55	0.35	0.20	0.39
Medium	0.19	0.31	0.36	0.27
Content & Medium	0.26	0.33	0.46	0.33

[a] N = 24

presented in Table 11. Post hoc comparisons of the scores for the children without photography experience showed that these children have significantly higher scores in the medium category when presented with documentary photographs ($p < .01$), and showed a stronger tendency to discuss depicted content in response to the remaining three types of photographs. These children also had significantly higher scores in the medium category than in the content and medium category across all four types of photographs ($p < .05$).

Among the late concrete operational with photography experience children the effect of experience with the medium facilitated the discussion of the interaction of content and medium and seems to have increased the variability of the children's responses. These children showed the strongest tendency to discuss the depicted content when presented with documentary photographs ($p < .01$); with straight, they discussed either content or the interaction of content and medium ($p < .01$); while their responses to formal and metaphoric photographs were equivalent across all three response categories.

Among the formal operational children, the effects of experience with photography had similar results. The summary scores for the formal operational children without photography experience and with photography experience are presented in Table 12. The children without photography experience had the highest scores in the content category when responding to

Table 11

Late Concrete Operational Children:
Summary Scores Presented by Experience With Photography,
Response Category and Type of Photograph[a]

	No Photography Experience			Photography Experience		
Type of Photography	Content	Medium	Content & Medium	Content	Medium	Content & Medium
Documentary	0.23	0.46	0.28	0.46	0.27	0.27
Straight	0.53	0.27	0.19	0.42	0.25	0.33
Formal	0.40	0.34	0.26	0.32	0.35	0.32
Metaphoric	0.42	0.37	0.20	0.31	0.34	0.33

[a] N = 24

Table 12

Formal Operational Children:

Summary Scores Presented by Experience With Photography, Response Category and Type of Photograph[a]

	No Photography Experience			Photography Experience		
Type of Photography	Content	Medium	Content & Medium	Content	Medium	Content & Medium
Documentary	0.59	0.16	0.25	0.52	0.22	0.25
Straight	0.43	0.27	0.29	0.27	0.36	0.36
Formal	0.26	0.42	0.31	0.15	0.29	0.54
Metaphoric	0.50	0.22	0.26	0.27	0.31	0.41

[a] N = 24

documentary, straight and metaphoric photographs ($p < .05$). Only when responding to the formal photographs did the children score significantly higher in the medium category ($p < .05$).

The formal operational children with photography experience discussed the depicted content significantly more when presented documentary photographs ($p < .01$); their responses were equivalent across all three categories when presented straight photographs; and showed the strongest tendency to discuss the interaction of content and medium when presented either formal or metaphoric photographs ($p < .05$). Thus, the effects of experience with photography on the formal operational children increased the likelihood of discussing the interaction of content and medium and increases the variability of their responses to the different photographs.

The analysis of the twelve-year-old children's scores has indicated that both cognitive level and experience with photography influence the nature of their responses. With increasing cognitive abilities, the formal operational children showed a greater tendency to discuss the interaction of content and medium, while the late concrete operational children discussed either depicted content or medium characteristics. Also the formal operational children were more sensitive to the various types of photography responding

differently to different styles. Experience with photography influenced the responses of both late concrete operational and formal operational children. Both groups increased their tendency to discuss the interaction of content and medium and showed variability in their responses to the different types of photographs.

This analysis of the children's responses to the photographs must be considered in contrast to the children's responses to the interview questions. When responding to the interview, the eight-year-old children discussed either the depicted content or characteristics of the photographic medium; when responding to specific photographs, these children showed the strongest tendency to discuss only the content. Also, when responding to the interview, the eight-year-old children with photography experience showed more of a tendency to discuss the medium limitations; their responses to the photographs revealed no such effect.

The twelve-year-olds' responses to the interview revealed a tendency to discuss the interaction of content and medium. This tendency was influenced by cognitive level with the formal operational children scoring higher in this category than the late concrete operational children. Experience with photography also influenced their responses increasing the tendency to discuss medium limitations. In

responding to the photographs, the twelve-year-old children showed a sensitivity to the type of photograph and varied their responses. Both differences in cognitive level and experience with photography influenced the nature of their responses. Children demonstrating formal operational skills showed more varied responses across the types of photographs and a tendency to discuss the interaction of content and medium for certain photographs. The late concrete operational children were less varied in their responses discussing either the depicted content or the medium. Experience with photography also facilitated more varied responses and a discussion of the interaction of content and medium for certain photographs for both late concrete operational and formal operational children.

These findings revealed some discrepancies, but also marked similarities to the interview data making it unlikely to explain the children's responses as simply an artifact of methodology or as an accurate illustration of how children understand a representational medium. A characterization of children's thinking about photography will require interpretation. Any explanation will have to account for the range of responses made evident by both methods of study.

DISCUSSION

It has been argued in line with Gombrich and others that beyond the ability to perceive the optical information contained in a picture, the comprehension of pictorial information requires an ability to consider the pictorial medium itself and its functions in the process of representation. Such a position maintains that the comprehension of pictures is as much a cognitive phenomenon as it is a perceptual achievement. This study was designed for the purpose of determining the nature of thought about pictorial means of expression and its function in comprehending meaning. This study involved a developmental methodology attending to changes in thought from middle childhood to early adolescence in order to examine the formation of this thought and the influence of general cognitive abilities and direct experience with the medium. The particular medium that was studied is photographic.

Two generalizations can be made before discussing the specific characteristics of the findings. First, the results indicate that the comprehension of pictorial information involves more than simply the pick up of optical information necessary to identify the three dimensional contents depicted in a picture. The ability to perceive this information is usually present by eighteen months of age (Hochberg & Brooks, 1962). In this study, both eight-and twelve-year-old

children expressed a variety of responses to the interview questions and the presentation of the photographs. The meaning of a photograph is not simply confined to the recognition of the depicted content. At both age levels, the children showed some ability to consider not only the content, but also the technical characteristics and limitations of the photographic medium.

Secondly, the overall results indicated that children's thinking about photography undergoes change between the ages of eight and twelve years. When asked questions about photography, the eight-year-old children responded by discussing either the depicted content or the characteristics of the medium. These two concerns are discussed separately in isolation from one another. When the eight-year-old children were asked to respond to specific photographs, they show the strongest tendency to discuss only the contents regardless of the type of photograph. The twelve-year-old children when responding to the interview questions, showed the strongest tendency to discuss the interaction of content and medium. When responding to the different photographs, they showed a variety of responses and an ability to discuss the interaction of content and medium for certain types of photographs.

Sigel (1978) has provided a cognitive explanation for the comprehension of pictorial information derived from

a Piagetian perspective. According to Sigel, the comprehension of pictorial meaning requires the consideration and coordination of information about the depicted content and the characteristics of the medium. To understand the meaning of a picture, the identity of the depicted content must be maintained despite the transformations that occur as a result of the medium, such as the reduction from three dimensions to two dimensions, or the difference in size of the object depicted in the picture. This ability to comprehend the meaning of pictures is believed to be a result of children's developing ability to conserve and the establishment of concrete operational thought.

In the present study, differences in the responses of the children were not clearly explained by Sigel's position. The eight-year-old concrete operational children, having demonstrated the ability to complete a conservation and class inclusion task, did not show a significant increase in their tendency to discuss the interaction of content and medium compared to the preoperational children in either the interview or when responding to photographs. The tendency to discuss this interaction significantly increased only among the twelve-year-old children with the onset of formal operational skills in both the interview and when responding to particular photographs (see Tables 4 & 10); or with experience with photography when the children were responding to particular

photographs (see Table 12). Thus, the onset of concrete operational skills is not sufficient to explain the development of the ability to discuss the interaction of content and medium in comprehending photography. This ability is noted only among twelve-year-old children and is influenced by both the onset of formal operational skills and experience with the representational medium.

In considering these two generalizations, it appears that thinking about photography cannot be explained by perceptual or cognitive processes that function in understanding physical properties and laws. Comprehending the nature of photography is not complete when children acquire the ability to perceive the information necessary to recognize the contents depicted in photographs; comprehension is also incomplete with the ability to distinguish the depicted content and the characteristics of the photographic medium. The ability to appreciate the interaction of content and medium, which is the most sophisticated response given, is not evident until the children are twelve-years of age and have either acquired the ability of formal thought or have had some experience with the representational medium. The ability to coordinate various elements in thought and to conserve identity, characteristics of concrete operational thinking, does not by itself result in more sophisticated thinking about photography.

Understanding the nature of thought about this representational medium requires an approach different from the mere extension of general perceptual and cognitive processes used in thinking about the world of physical objects and events. Photography may need to be considered distinct from such concrete phenomena and comprehension requires a unique process. Development of this process would similarly involve a distinctive pattern of influences. Cassirer (1971) has argued for a distinction between the structural properties of natural object concepts and the structure of cultural concepts. "Nature concepts", involve the world of concrete physical phenomena, have universal characteristics, whose various components are fixed and appear in a causal relationship to one another; Cassirer gives the example of gold and silver as components of the concept of metal. "Culture concepts", on the other hand, have an indeterminate relationship between their component parts, such as a group of individuals that can be conceptualized as Renaissance men, each unique and distinct from the others, yet all can be classified together. This indeterminate relationship allows for individual expression, vis-a-vis nature concepts are not structured for such uniqueness. The exact way in which these components function in expression is influenced by experience in a particular cultural setting which specifies standards and traditions in style and form.

While this study cannot fully address all of the aspects of Cassirer's distinction, it may be useful to consider thinking about photography as involving such a cultural concept in explaining the present findings.

Among eight-year-old children, thought about photography is at the level of understanding the concrete characteristics of the phenomenon. In the interview, the children distinguished the relevant components involved, the depicted content and the medium (see Table 2). There was no discussion of the interaction of these two components. Among the eight-year-old children without photography experience, their highest score revealed the tendency to discuss content limitations when thinking about photography (see Table 3). In a sense, the depicted content limits the nature of photography for them. Their scores for discussing medium limitations were significantly higher than any other category, but remains significantly lower than their score for discussing the content.

Among the eight-year-olds with photography experience, there was evidence of an increase in their awareness of the medium and its characteristics. Their highest scores were in the medium limitations category. For these children, the characteristics of the medium limited the nature of photography. For the eight-year-olds in general,

their understanding of photography involved an appreciation of either the depicted contents in a photograph or the characteristics of the medium. Both understandings involved only the distinction of the physical components that are present. Neither understanding involved the appreciation of how these components can be manipulated to serve as individual expressions.

The eight-year-olds' responses to the photographs can be explained as a characteristic of concrete operational thought. When these children responded to the various photographs, the highest score was in the category that represents a discussion of the depicted content (see Table 7). The children discussed content despite their tendency to discuss the medium limitations in the interview. Also these children discussed the depicted content regardless of the different styles of photographs presented. Differences in cognitive ability and experience with photography had no effect. These findings are in accord with Piaget's emphasis on the importance of concrete material in concrete operational thinking by demonstrating the impact of having an actual photograph present in directing the children's thinking to consider the depicted content.

The twelve-year-old children begin to comprehend photography as a cultural concept. Photography at this level was not merely the physical characteristics presented in the

representation, but rather involved understanding a photograph as one expression from a range of possible expressions that an individual can compose by the manipulation of content and medium characteristics. At this level of understanding, the photographic expression is not just the extension of the physical properties of the depicted content, nor is it just the product of the photographic technique, it is instead an expressed statement of the photographer who may have particular ideas or reasoning that motivated the expression.

Thinking about photography in this way would have to involve some of the abilities that are characteristic of formal operational thought. Inhelder and Piaget (1958) describe the early adolescent as having acquired the ability to consider hypothetical statements as instances in relation to a set of all possible instances. Thus, for children who have demonstrated some formal operational skills, understanding photography and photographs does not have to be confined to either the depicted content or the techniques of the medium, but content and medium can be considered parameters between which various expressions can be composed. Responses by children who understand photography in this way would involve the discussion of the interaction of content and medium. This ability of hypothetical reasoning corresponds with the children understanding the indeterminate relationship between content and medium. The findings of this study indicate that

the twelve-year-old children discussed the interaction of the content and medium significantly more in the interview (see Table 2), and that this tendency was facilitated by the onset of formal operational skills (see Table 6). In responding to the photographs, the twelve-year-olds also showed a tendency to discuss this interaction, but only with particular photographs (see Table 8).

Piaget and Inhelder also demonstrate that children with formal operational skills have the ability to consider propositional statements as part of a reasoning process independent of an actual occurance. Children capable of understanding photography as a cultural construct would have to show an awareness of the individual motivations or reasoning behind the composition of a photograph and be sensitive to the different forms they may take. The present findings revealed that the twelve-year-old children show greater sensitivity to various styles of photographs (see Table 8), than the eight-year-old children who did not show any significant variations in their responses with regard to style. This sensitivity to style was even greater among the formal operational children (see Table 10). It appears that if a style presents a clear depiction of content material, as in documentary or straight photographs, these children discussed the depicted content. If a style distorts the depicted content or appears contrived in some way, as in

formal or metaphoric photographs, the children responded by discussing the medium or the interaction of content and medium to explain the discrepancy from the clear depiction of content.

Although there exists a correspondence between formal operational skills and thinking about photography as a cultural phenomenon, it is not the case that thinking about this representational medium is exclusively determined by the onset of formal operations. The discussion of the interaction of content and medium was facilitated by experience with the medium. Late concrete operational children with photography experience discussed the interaction of content and medium as much as other types of responses (see Table 11). While those children without photography experience showed the strongest tendency to discuss either content or medium. Thus, development in thinking about photography was not only determined by the onset of thinking in formal terms, but also by experience with the accepted uses and techniques of the medium.

This study has provided descriptive information of how children think about photography and has suggested how such thinking develops. Thinking about photography has been described as concerning two fundamental components or dimensions. The first involves the identity of the content depicted in photographs. The second involves consideration of the characteristics and limitations of the photographic

medium. Contrary to many developmental phenomena demonstrating a sequential pattern of change, the present data suggests a pattern of synchrony between these two dimensions. Awareness and concern for content and medium characteristics are present at eight years of age albeit separately, in isolation from one another. At twelve years of age, these two dimensions are integrated in comprehending the nature of photography.

Multi-dimensional thought, changing in a pattern of developmental synchrony, may have a variety of sources and effects. The present data has revealed that both general cognitive skills as well as specific experiences influence thinking about photography. However, these effects are distinct. Thinking about photography cannot be reduced to either one as a more determining influence. Both seem to have had an effect that is necessary for the comprehension of this representational medium. Experience with photography affected both eight-and twelve-year-olds by increasing their awareness of the limitations of the photographic medium. It may be that the development of this awareness detached photographic meaning from being limited by the depicted content and makes it a distinct object of thought, with unique characteristics that need to be considered. The onset of formal operational skills seems to have facilitated the consideration of the unique characteristics such as the

hypothetical nature of a photography as well as the propositional statement it may represent. However, conceptualizing photography in this way was not strictly determined by formal operational thought. Experience with the medium, among the twelve-year-olds, also facilitated this more sophisticated type of thinking. It appears that experience with the intentional manipulation of content and medium may result in the same outcome that formal operational skills had on thinking about photography.

The nature of this thought and pattern of development has been discussed as distinct from perceptual and cognitive processes involved in understanding physical substances and properties. Instead, thinking about photography has been formally constrained as a process of thought involving a cultural phenomenon. This formalization stressed the indeterminate relationship between various components or dimensions, the manipulation of these dimensions to serve the purpose of individual expression, and the influence of individual experience on the style and form of the expressions.

If thinking about photography is to be considered one example of a form of thought characteristic of other representational media and cultural phenomena, then further comparison with other media and phenomena is needed. Support that this characterization will generalize to other forms comes most directly from studies of language. Beilin (1975) demonstrated

the semi-autonomous relationship between language and thought. Beilin argues that in addition to the contributions of general cognitive abilities, language has unique properties of its own that contribute to this relationship. Bates and Mac Whinney (1980) also argue that the constraining characteristics of language are important in determining the course of acquisition. Others have been pursuing similar positions with regard to various phenomena (Grossberg, 1980; Fischer, 1980; Feldman, 1980; Keil 1981). Most informative for the present position would be a comparison with some other visual media such as painting, drawing or film.

The establishment of a relationship between thinking about photography and other cultural media and phenomena will require a more careful examination of media knowledge. In the present study, knowledge of photography was coded in its most general form. The acquisition of such information as the importance of focus, distance, station point and lighting in the composition of a photograph needs to be specified. Identifying this kind of information should make comparisons with other media more direct and informative. The specification of media knowledge requires the use of more sensitive category schemes and interview techniques.

Finally, if this distinction between thinking about photography and other cultural phenomena from general cognitive processes used in comprehending physical properties is warranted,

then the full nature of this thought may not have been revealed in the present study. This study seems to have focused on the development of an ability to appreciate the indeterminate relationship between content and medium. Consideration of aesthetic responses and a fuller appreciation of style are important aspects that were not explored in the present methodology. These aspects are important in understanding how individual expression is achieved and appreciated in representational media. Extending this study to examine the full range of this type of thinking would also require the use of more sensitive coding schemes and interview techniques.

In conclusion, this study has involved the process of representation and has examined the influence of the specific characteristics of the medium of expression on this process. It was found that the medium of expression is an important component in understanding the nature of representation. Awareness and thought about the medium of expression, however, goes beyond the recognition of specific characteristics and techniques, and involves an understanding of the complex relationship between the medium of expression, the intentional use of that medium to serve individual expression, and the cultural content for that use. The present study suggests the independent nature of this understanding from other cognitive processes and the distinctive pattern of its formation.

BIBLIOGRAPHY

Arnheim, R. Art and visual perception: A psychology of the creative eye. California: University of California Press, 1974.

Arnheim, R. On the nature of photography. Critical Inquiry. 1974, 9, 149-161.

Arnheim, R. Film as art. California: University of California Press, 1957.

Baldwin, J.M. Genetic theory of reality. New York: C.P. Putnam, 1915.

Barthes, R. The photographic message. In Image, Music, Text. New York: Hall and Wang, 1977.

Bates, E. & Mac Whinney, B. The functionalist approach to the acquisition of grammatical categories. In E. Wanner and L. Gleitman (eds.), Child Language. Massachusetts: Harvard University Press, 1980.

Beilin, H. Studies in the cognitive basis of language development. New York: Academic Press, 1975.

Beilin, H. Children's comprehension of photographic representation. Paper presented at the National Symposium for Research in Art Conference, Learning in Art, Illinois, 1980.

Berzonsky, M. Interdependence of Inhelder and Piaget's model of logical thinking. Developmental Psychology, 1971, 4, 469-476.

Bruner, J. The growth of representational processes in childhood. In J.M. Anglin (ed.), Beyond the information given. New York: W.W. Norton & Co., Inc., 1973.

Cassirer, E. Nature concepts and culture concepts. In The logic of the humanities. Connecticut: Yale University Press, 1971.

Dirks, J. & Gibson, E. Infants perception of similarity between live people and their photographs. Child Development, 1977, 48, 124-130.

Duncan, H. How Africans see pictures. New York: New Readers Press, 1962.

Ecker, D. Analyzing children's talk about art. Journal of Aesthetic Education. 1973, 7, 58-73.

Feldman, D.H. Beyond universals in cognitive development. New Jersey: Ablex Publishing Corp., 1980.

Fischer, K.W. A theory of cognitive development: The control and construction of hierarchies of skills. Psychological Review, 1980, 87, 477-531.

Friedman, S.L. Perception of movement in pictures. In M. Hagen (ed.), The perception of pictures. New York: Academic Press, 1980.

Gardner, H. The development of sensitivity to figural and stylistic aspects of paintings. British Journal of Psychology, 1972, 63, 605-615.

Gardner, H. Children's sensitivity to musical styles. Merrill-Palmer Quarterly, 1972, 5, 93-114.

Gardner, H. The arts and human development. New York: John Wiley & Sons, 1973.

Gardner, H. Metaphor and modalities: How children project adjectives onto diverse domains. Child Development, 1974, 45, 84-91.

Gardner, H., Winner, E., & Kircher, M. Children's conceptions of the arts. Journal of Aesthetic Education, 1973, 9, 60-77.

Gibson, J.J. A theory of picture perception. Audio-Visual Communication Review, 1954, 1, 3-24.

Gibson, J.J. The information available in pictures. Leonardo, 1971, 4, 37-55.

Gibson, J.J. The ecological approach to visual perception. Massachusetts: Houghton Mifflin Co., 1979.

Gombrich, E. Art and illusions: A study in the psychology of pictorial representation. New Jersey: Princeton University Press, 1961.

Goodman, N. Languages of art. New York: Bobbs Merrill, 1968.

Grossberg, S. How does a brain build a cognitive code? Psychological Review, 1980, 81, 1-15.

Hagen, M.A., & Jones, R.K. Cultural effects on pictorial perception: How many words is one picture really worth? In H. Dick & R. Walk (eds.), Perception and Experience, New York: Plenum Press, 1978.

Hagen, M.A. The perception of pictures. New York: Academic Press, 1980.

Herrnstein, R.J., & Loveland, D.H. Complex visual concepts in the pigeon. Science, 1964, 146, 549-551.

Hochberg, J. The representation of things and people. In E. Gombrich, J. Hochberg & M. Black (eds.), Art perception and reality. Maryland: The John Hopkins University Press, 1972.

Hochberg, J. & Brooks, V. Pictorial recognition as an unlearned ability: A study of one child's performance. American Journal of Psychology, 1962, 75, 624-628.

Hudson, W. Cultural problems in pictorial perception. The South African Journal of Science, 1962, 58, 189-195.

Inhelder, B. and Piaget, J. The growth of logical thinking from childhood to adolescence. London: Routledge, Kegan, Paul, 1958.

Jahoda, G., Deregowski, J., Ampene, H., & Williams, N. Pictorial recognition as an unlearned ability. In G. Butterworth (ed.), The child's representation of the world. New York: Plenum Press, 1977.

Keil, F.C. Constraints on knowledge and cognitive development. Psychological Review, 1981, 88, 197-227.

Kennedy, J.M. A psychology of picture perception. New York: Jossey-Boss, 1974.

Kohler, W. The mentality of apes. London: Routledge, Kegan, Paul, 1925.

Kose, G., Beilin, J. & O'Connor, J. Children's comprehension of actions depicted in photographs. Paper presented at the Sixth Biennial Conference on Human Development, Alexandria, Virginia, 1980.

Levin. J.R. What have we learned about maximizing what children learn? In J.R. Levin & V.L. Allen (eds.), Cognitive learning in children. New York: Academic Press, 1976.

Lovell, K. A follow-up study of Inhelder and Piaget's The growth of logical thinking. British Journal of Psychology, 1961, 52, 143-153.

Machotka, P. Aesthetic criteria in childhood: Justification of preference. Child Development, 1966, 37, 877-888.

Matejka, L. & Titunik, I. Semiotics of art: Prague school contributions. Massachusetts: The MIT Press, 1977.

McLuhan, M. Understanding Media. New York: Signet Publishing, 1964.

Newhall, B. The history of photography. New York: The Museum of Modern Art, 1978.

Nineo, A. & Bruner, J. The achievement and antecedents of labelling. Journal of Child Language, 1978, 5, 1-15.

Novitz, D. Picturing. Journal of Aesthetics and Art Criticism, 1975, 34, 145-155.

Novitz, D. Pictures and their uses in communications. The Hague: Martinus Nijhoff, 1977.

O'Connor, J., Beilin, H. & Kose, G. Children's understanding of photographic information. Paper presented at the Psychonomic Society Meetings, Phoenix, Arizona, 1979.

O'Connor, J. Transitivity and representation. Unpublished doctoral dissertation, City University of New York, 1980.

Olson, D.R. Cognitive development: The child's acquisition of diagonality. New York: Academic Press, 1970.

Olson, D.R. Media and symbols: The forms of expression, communication and education. Illinois: The National Society for the Study of Education, 1974.

Pearlman, E., & Beilin, H. Pictorial realism: A study of photographs as symbolic entities. Unpublished manuscript, City University of New York, 1979.

Piaget, J. Play, dreams and imitations in childhood. New York: W.W. Norton, 1962.

Piaget, J. The child's conception of number. New York: W.W. Norton, 1965.

Piaget, J. & Inhelder, B. The origin of the idea of chance in children. New York: W.W. Norton, 1975.

Reznick, H.M. Developmental changes in children's strategies for processing pictorial information. Merrill-Palmer Quarterly, 1977, 23 (3), 143-162.

Rohwer, W.D. Images and pictures in children's learning: Research results and instructional implications. Psychological Bulletin, 1970, 73, 393-403.

Rose, S.A. Infants transfer of response between two dimensional and three dimensional stimuli. Child Development, 1977, 48, 1086-1091.

Sigel, I.E. The development of pictorial comprehension. In B.S. Randhawa & W.E. Coffman (eds.), Visual learning, thinking and communication. New York: Academic Press, 1978.

Snyder, J. Picturing vision. Critical Inquiry, 1980, 6 (3), 499-526.

Snyder, J. & Allen, N.W. Photography, vision and representation. Critical Inquiry, 1975, 2 (1), 143-171.

Soloman, G. Interaction of media, cognition and learning. California: Jossy-Boss Publishing, 1980.

Wartofsky, M. Visual scenarios: The role of representation in visual perception. In C. Nodine & D. Fischer (eds.), Perception of pictorial representation. New York: Wiley and Sons, 1978.

Werner, H. & Kaplan, B. Symbol formation. New York: Wiley and Sons, 1973.