AN EXPLORATORY STUDY OF INFANTS' ABILITY TO GENERALIZE

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CHAPTER I

INTRODUCTION

Purpose

The purpose of this research is to examine infants' responses to visual stimuli. This will include a study of preferences, a study of the ability to generalize, and a study of changes which may occur with increased maturity.

Definition

Generalization is defined as the formation of concepts covering all the objects of a given class that have one or more characteristics in common.

Problem

An understanding of the processes of maturation and learning in infancy is needed for one to understand infant cognition. For several decades this basic research problem has been approached in a variety of ways. In early studies maturation as reflected in sensori-motor development was used as the criterion of infant intelligence. Conditioning techniques were also employed in studies of the learning ability of infants. More recently attempts have been made to study cognitive development *per se*.

To the extent that the present research increases our knowledge of the generalization abilities of infants, it will contribute to our understanding of infant learning. In this research infants' responses to visual stimuli will be studied, and the presence or absence of preferences for color, size, and form will be examined for indications of the ability to generalize. Attention will also be focused on changes which may occur with increased maturity.

Procedure

The following steps were involved in the development of an instrument for use with infants in the study of preferences for color, size, and form, the ability to generalize, and changes which may occur with increased maturity:

1. The literature was reviewed to gain an understanding of theory related to discrimination and generalization in infancy and an understanding of the research methods that may be appropriate for this area of study.

2. Pilot work was done to clarify the criteria for the instrument.

3. The instrument was developed.

4. The instrument was administered to 71 infants ranging in age from four months through 17 months.

5. The data were analyzed.

6. The results were interpreted and recommendations were made for future research.

CHAPTER II

REVIEW OF LITERATURE

Introduction

The study of learning and cognitive development necessarily includes the study of concept formation; therefore, inasmuch as concepts are formed by the combined processes of discrimination and generalization, the study of cognitive development in infancy must include a study of the ability to discriminate and generalize.

This chapter will include a report of evidences of the ability to discriminate, methods used to study discrimination, evidences of generalization, and implications for the present research.

Evidence of the Ability to Discriminate

Investigators concerned with the process of discrimination in infancy and early childhood have studied discrimination of color, size, and form.

Staples (1932) studied the responses to colors of infants up to twenty-four months of age. Her study revealed preferences for colored rather than grey objects up to three months of age. From ages two to four and one-half months, infants stared significantly longer at yellow

discs than they did at grey ones. From five and one-half months to two years of age, color preferences were for red, yellow, blue, and green in that order.

Chase (1937) studied color discrimination of infants fifteen to seventy days old. All his subjects were able to discriminate between colors. There were no age differences, and there was no evidence that any one color combination could be discriminated better than any other.

Ling (1941) found that infants six months of age and older could be taught to discriminate between three-dimensional objects. Skeels (1933) studied children 15 to 46 months old and found that all were able to discriminate between different shaped blocks: lozenges, cubes, spheres, and crosses.

Most research concerned with size discrimination has used as subjects young children rather than infants. Cruikshank (1941) found evidences of size discrimination in her study of visual size constancy in early infancy.

Brian and Goodenough (1929), using a method of forced choices, studied the potency of color and form perceptions. They found that children up to three years of age matched objects on the basis of form. Children from three to six years of age matched on the basis of color. They interpreted these findings as an indication that an early interest in form might be the result of the importance of form in the young child's first attempts at classifying and organizing his perceptions.

Methods Used to Study Discrimination

Several methods have been used to study infants' ability to discriminate. Staples (1932) used duration of visual fixation as an indication of color preferences. Chase (1937) used pursuit movements of the eyes as evidence of the ability to discriminate. The stimulus was a moving spot of color which differed from its background only in hue. If the infants followed the moving spot with their eyes, they were assumed to be discriminating. Ocular pursuit was evident in all the infants. These infants were 15 to 70 days old.

Conditioning techniques have frequently been used to study form discrimination. Ling (1941) presented the infants with two or more blocks differing in form. These forms were presented on a board to which the "incorrect" forms were fastened so they could not be picked up. The "correct" form to which the infants were being conditioned was sweetened with saccharine and could be lifted and mouthed. Skeels (1933) also used conditioning techniques and found that children 15 to 46 months old could discriminate between different shapes: lozenges, spheres, cubes, and crosses.

The reports of persons blind from birth who have regained their sight have provided evidence about the development of perceptual discrimination. Von Sender (1954) used reports of 65 persons blind from birth who regained

their sight following cataract operations. These subjects first learned to name colors. They were then able to discriminate size, distance, and movement. Next they developed the ability to recognize forms. Recognition was usually lost if the object was changed in some manner, such as color, or was moved. The ability to generalize came much later.

Evidence of Generalization

The phenomenon of generalization has been demonstrated in numerous studies with both animals and humans (e.g. Hovland, 1937; Grandine and Harlow, 1948; Grant and Schiller, 1953; and Brown et al, 1958). Most studies of generalization employ a conditioning technique. In such studies a subject who has been conditioned to respond to a particular stimulus responds in the same manner to similar stimuli. This ability of different stimuli to evoke a conditioned response is termed stimulus generalization. One of the best known demonstrations of stimulus generalization was reported by Watson and Raynor (1920). Albert, their eleven-month-old subject, was taught to fear a white rat, and this fear response was subsequently elicited by a Santa Claus mask, a fur coat, cotton, a rabbit, and other furry objects.

Gellerman (1933) offered as evidence of generalization the ability of two-year-old children to discriminate triangles regardless of changes in size, position, and background.

Waring (circa 1927) studied selecting and generalizing abilities of infants twelve and eighteen months of age. The four relationship patterns explored in her study were (1) relationship by use, (2) relationship by fitting together, (3) relationship by likeness, and (4) relationship by size. She found evidences of generalization at both twelve and eighteen months of age.

Implications for the Present Research

Implications for the present research can be drawn from reports of earlier studies of discrimination and generalization.

1. Infants as young as two months of age show color preferences.

2. Infants six months of age and older can be taught to discriminate between three-dimensional objects.

3. There is some indication that infants can discriminate between different sizes.

4. There is an indicated course of development of visual perception.

5. There is evidence that infants as young as eleven or twelve months old can generalize.

CHAPTER III

DEVELOPMENT OF THE INSTRUMENT

This chapter will include a description of the subjects and a detailed discussion of the development of the research instrument.

Subjects

The subjects used in this research were 71 infants ranging in age from four months through seventeen months. With few exceptions, they were the children of faculty or students at Oklahoma State University.

Pilot Work

Step One

Dr. Ethel Waring (circa 1927), in her study of selecting and generalizing ability in infancy, suggested that at approximately twelve months of age an infant is interested in simultaneous manipulation of objects with both hands. Therefore, when three objects are placed before an infant, he will select two of these.

In the present research an attempt was made to use simultaneous grasping behavior in a pilot study of infants' ability to generalize. The infants were presented with

three objects and the expectation was that two of these would be grasped simultaneously. This expectation was false. The objects were presented to six infants aged ten to twelve months. All of these infants refused to select more than one object; therefore, this method of studying the ability to generalize was discarded.

Step Two

In Step Two of the pilot work, infants' responses to paired objects were studied. For the testing, younger infants were seated in Infanseats specifically designed to hold young infants in a sitting position. Older infants, those able to sit independently, were seated in their high chairs. A few resisted their high chairs and preferred to play seated on the floor.

Three different sets of testing materials were assembled, each set consisting of ten pairs of styrofoam objects. In the first set, one of each pair differed from the other in color. In the second set, one of each pair differed from the other in size. In the third set, one of each pair differed from the other in form. The six colors used were red, black, white, blue, green, and yellow. The three forms used were spheres, cubes, and pyramids. The objects were one and two inches in diameter or height.

For the younger infants, the experimenter presented the paired objects to the infant by holding one in each hand, between the forefinger and thumb, with her hand below and behind the object. In this way, the palms of her hands

served as the background for the objects as the infant saw them. The experimenter moved the two objects from left to right at the infant's eye level, then back and down to a position between the infant's hands. If the infant did not appear to watch the objects, the back and forth motion was repeated until he did show ocular pursuit. Any reaching movement toward an object, with or without contact, was accepted as a positive response to that object. If the infant looked away and made a reaching movement while looking elsewhere, the presentation was repeated. If the infant actually grasped one object, he was allowed to manipulate it for a few seconds. The object was then removed from his hand and two more were immediately presented.

For the older infants the objects in each pair were placed about three inches apart in the middle of the high chair tray. Most of these infants responded to the objects immediately. If the infant did not notice them, the experimenter tapped the tray to attract his attention. As with the younger subjects, these older infants were allowed to manipulate the chosen object for a few seconds before the next pair was presented.

For all subjects, the chosen object was removed immediately if the infant put it to his mouth.

This procedure was tested with six infants. Their responses indicated that (1) infants as young as four months old do have color preferences, (2) white should be eliminated

as one of the colors in the task because the infants consistently rejected it, and (3) pyramids should be eliminated for the same reason.

The Research Instrument

The observations made during the pilot studies gave direction to the design of the research instrument. During the actual use of the instrument certain modifications were necessary as indicated by the infants' responses to the instrument.

Subjects

The subjects used in this research were 71 infants ranging in age from four months through 17 months. Age groupings by months are shown in Table I.

TABLE I

DISTRIBUTION OF SUBJECTS BY AGE
(N=71)

Age in Months	Number of Subjects	Age in Months	Number of Subjects
4	10	10	5
5	10	11	3
6	9	12	1
7	8	13	5
8	10	14	1
9	8	17	1

Description of the Instrument

Five different sets of testing materials were assembled for the research instrument. Set I was designed to test color preferences. Set II was designed to test size preferences and generalization based on the concept of relative size. Set III was designed to test form preferences and generalization based on the concept of roundness. Set IV was designed to test generalization based on the concept of spheres. Set V was designed as a modification of Set I to test color preferences of infants older than six months of age. (See Appendix A for a description of the objects and the order of presentation.)

In Set I, for the testing of color preferences, 20 pairs of one-inch cubes were used. The cubes in each pair differed in color; and the five colors used in the task were red, black, blue, green, and yellow. Each color was paired twice with every other color, and each color was presented on the right four times and on the left four times.

In Set II, for the testing of size preferences and generalization based on the concept of relative size, 20 pairs of cubes were used. Ten pairs were blue and ten were green. The cubes in each pair differed in size, and the five sizes used in the task ranged from a three-fourths inch cube to a one and three-fourths inch cube. Each size was paired twice with every other size, and each size was presented on the right four times and on the left four times.

In Set III, for the testing of form preferences and generalization based on the concept of roundness, 20 pairs of objects were used. Ten pairs were blue and ten were green. The objects in each pair differed in form; and the five forms used in the task were spheres, cubes, rectangles, flat triangles, and flat circles. All objects were of approximately the same height or diameter. Each form was paired twice with every other form, and each form was presented on the right four times and on the left four times.

In Set IV, for testing generalization based on the concept of spheres, ten pairs of objects were used. The paired objects differed only in form, and one object in each pair was a sphere. Five colors, two sizes, and three forms were used in the task. The colors were red, black, blue, green, and yellow. The sizes were one inch and one- and one-fourth inches in height or diameter. The forms were spheres, cubes, and triangles. This set was administered only to those infants who selected spheres six of the eight possible times during the test for form preferences. The need for this set was indicated by a preference for spheres which was demonstrated by six of the first ten infants tested.

In Set V, for the testing of color preferences of infants over six months of age, 20 pairs of one-inch spheres were used. This set was identical to Set I except that spheres rather than cubes were used. The need for this set was indicated when many of the older infants did not respond

to the first color preference test in which all objects were cubes. These same infants rejected cubes in the form preference test and preferred spheres.

Procedure

The procedure used in Step Two of the pilot work was used for the research instrument.

Scoring

For each infant, 16 different raw scores are recorded. (See Appendix B, Table VI.) Each score indicates the number of times a particular object was chosen. Scores are presented for the five colors in Sets I and V, the five sizes in Set II, the five forms in Set III, and for the number of times spheres were chosen in Set IV (See Appendix B, Table VII). These raw scores are used to determine each infant's preferences and his ability to generalize.

Composite or derived scores are recorded to indicate the preferences and generalization ability of individual infants. (See Appendix B, Table VII.) Preferences for color, size, and form are recorded for each infant. The choice of an object at least six times out of eight (eight being the highest possible score) was accepted as indicative of a preference.

Scores indicating generalization ability are derived from preferences for objects of a given class which have one or more characteristics in common. In line with this

definition, the ability to generalize is present if preference scores indicate a concept of relative size or a concept of roundness.

In Set II, the test of size preferences, scores indicating the number of times the larger object and the smaller object in each pair were selected would indicate the presence or absence of a preference for relative size. Selection of the larger object, or the smaller object, at least two-thirds of the time was accepted as indicative of a preference and therefore as indicative of generalization based on a concept of relative size.

In Set III, the test of form preferences, spheres (A) and flat circles (E) were used as two of the forms. Marked preferences for these two forms were accepted as indicative of generalization based on the concept of roundness. The specific score was determined by the total number of times spheres and flat circles were chosen when paired with other objects in the set. (Formula: A + E - 2.) Scores of 11 or 12, which were the highest possible scores derived from this formula, were accepted as indicative of the ability to generalize.

In Set IV, a test of preference for spheres, the selection of the sphere seven times out of ten was accepted as indicative of a preference, and therefore as another indication of generalization based on a concept of roundness (spheres).

Recommended Analysis

The data gathered in this exploratory study should be analyzed for the existence of preferences, for evidence of the ability to generalize, and for possible age differences. These data can be presented most clearly in tables and graphs and will be presented in this manner in the next chapter. No statistical analysis will be attempted.

CHAPTER IV

RESULTS

A research instrument for the study of preferences and generalization in infancy was developed and administered to 71 infants ranging in age from four months through 17 months. The data describing the infants' responses are presented and discusses in this chapter. The scores of the individual children are presented in Appendix B.

Preferences

Color Preferences

Two types of objects were used to test color preferences, cubes in Set I and spheres in Set V. These sets were administered to 63 infants under one year of age. Of these infants, only 28 showed color preferences, and many refused this test completely even though enjoying other parts of the research instrument.

In Table II, page 19, color preferences by age are presented. These data indicate (1) that the younger infants showed color preferences more frequently than did the older infants, and (2) that the most frequently preferred colors were black and red.

The bar graph, Figure 1, page 20, represents the per cent of infants in each age group showing color preferences. The marked decline in color preferences after six months of age is clearly indicated in this figure.

Size Preferences

The test of size preferences, Set II, was administered to 63 infants under one year of age. Of these infants 43 showed size preferences. The data presented by age groups in Table III, page 21, indicate that the younger infants preferred the large objects exclusively, while some of the older infants showed a preference for the smaller objects. These data are graphically represented in Figure 2, page 22.

Form Preferences

The test of form preferences, Set III, was administered to 63 infants under one year of age. Of these infants 42 showed form preferences. The data presented by age groups in Table IV, page 23, indicate that preferences for spheres and flat circles increased steadily. The infants in the 10-11 months age group preferred only these two forms. The per cent of infants in each age group who showed form preferences is graphically represented in Figure 3, page 24.

TABLE II

COLOR PREFERENCES OF INFANTS
(N=63)

	Age in Months				
Color	4-5	6-7	8-9	10-11	Total
Black	6	3	0	1	10
Red	4	4	1	0	9
Yellow	2	3	1	0	6
Blue	1	1	1	0	3
Green	1	2	1	0	4
Total	14	13	4	1	32
Number of Infants	20	17	18	8	63
Number Showing Preferences*	12	11	4	1	28

* Some infants showed more than one color preference.

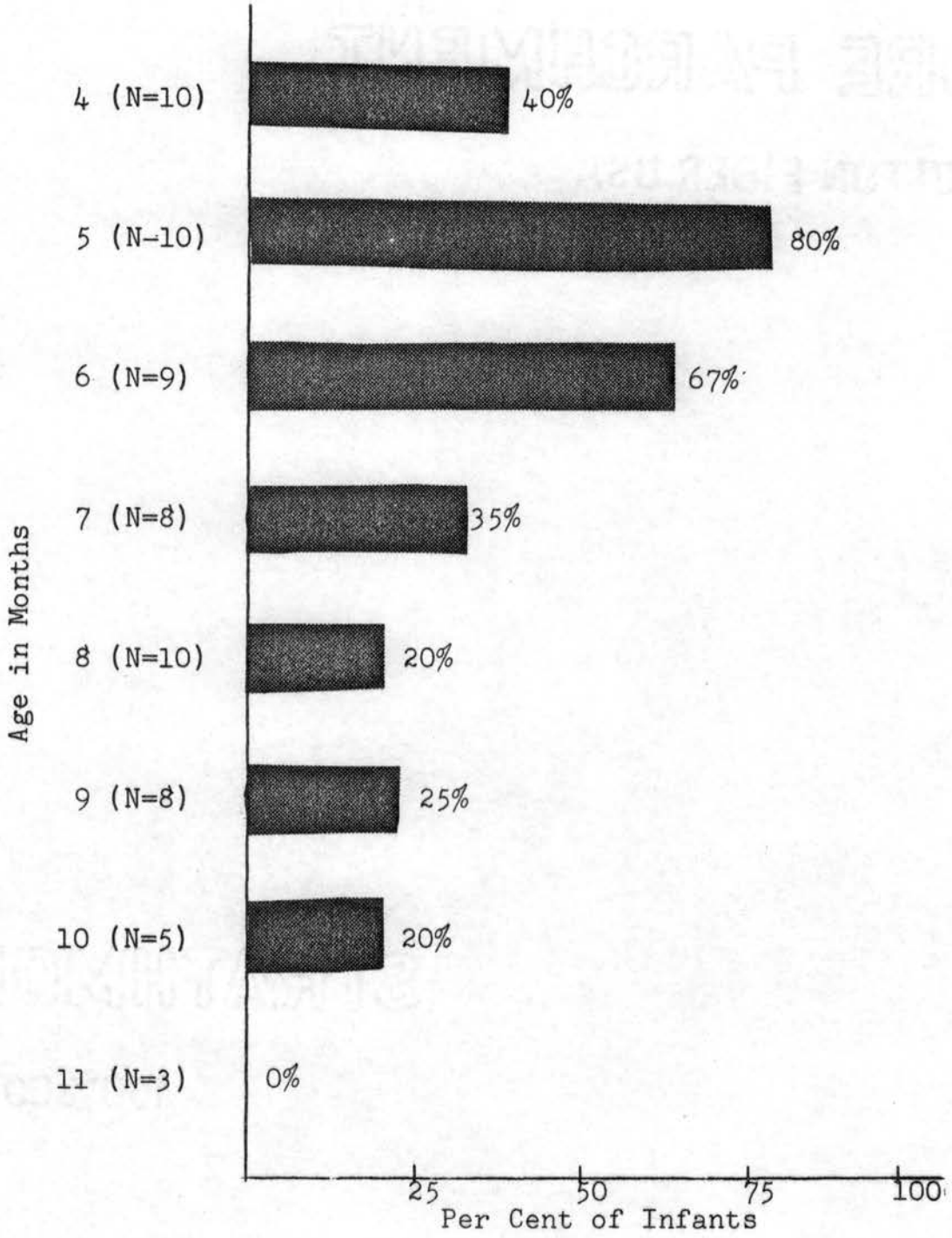

Figure 1. Per cent of infants in each age group showing color preferences. (N=63)

TABLE III

SIZE PREFERENCES OF INFANTS
(N=63)

	Age in Months				
Size of Cubes	4-5	6-7	8-9	10-11	Total
3/4"	0	0	2	2	4
1"	0	0	2	1	3
1¼"	0	0	0	1	1
1½"	4	6	4	2	16
1 3/4"	9	10	8	4	31
Total	13	16	16	10	55
Number of Infants	20	17	18	8	63
Number Showing Size Preferences*	10	13	12	8	43

* Some infants showed more than one size preference.

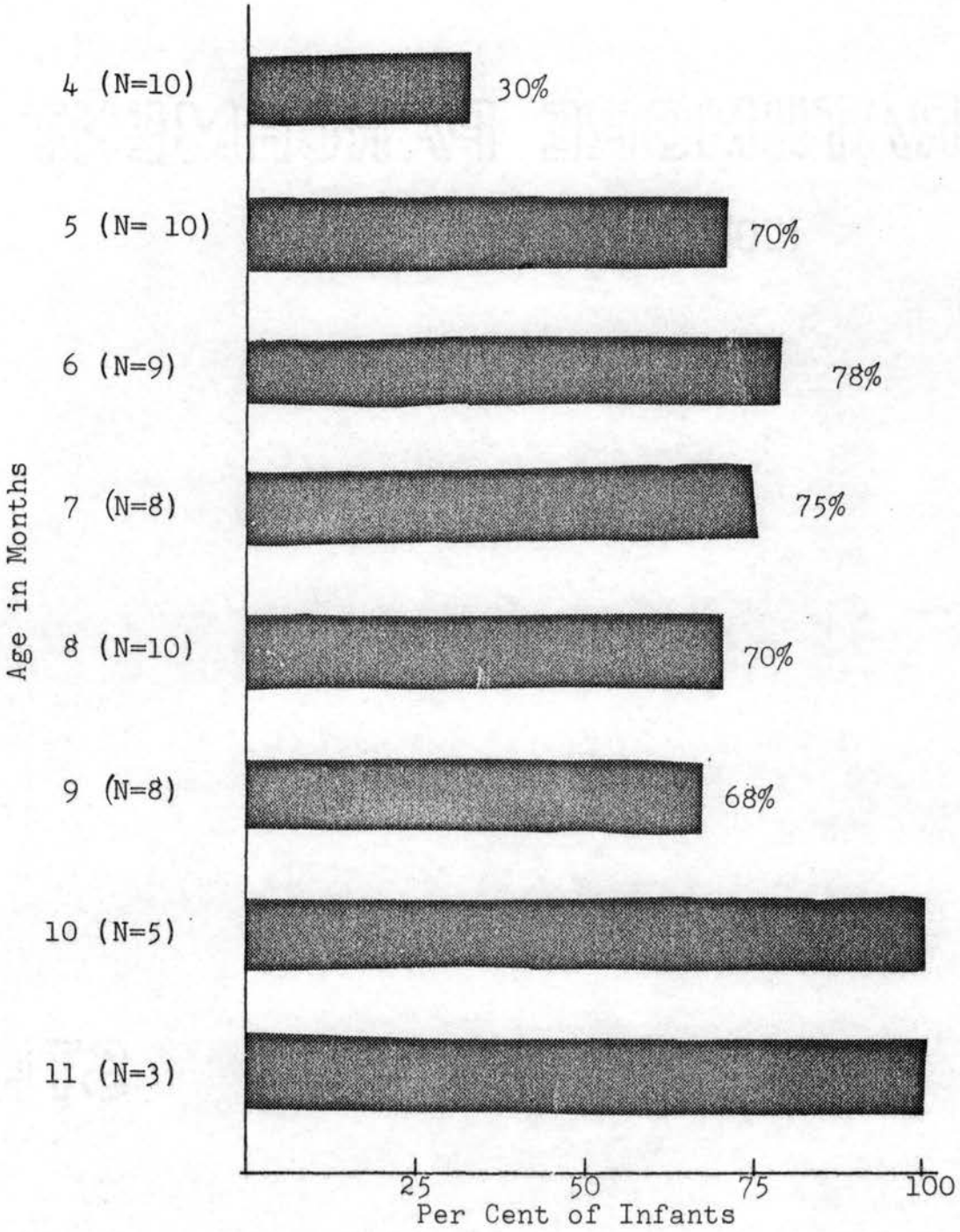

Figure 2. Per cent of infants in each age group showing size preferences. (N=63)

TABLE IV

FORM PREFERENCES OF INFANTS
(N=63)

	Age in Months				
Form	4-5	6-7	8-9	10-11	Total
Sphere	5	7	13	7	32
Cube	2	1	2	0	5
Rectangle	2	1	0	0	3
Triangle	0	1	1	0	3
Flat Circle	1	4	5	7	17
Total	10	16	20	14	60
Number of Infants	20	17	18	8	63
Number Showing Form Preferences*	8	11	16	7	42

* Some infants showed more than one form preference.

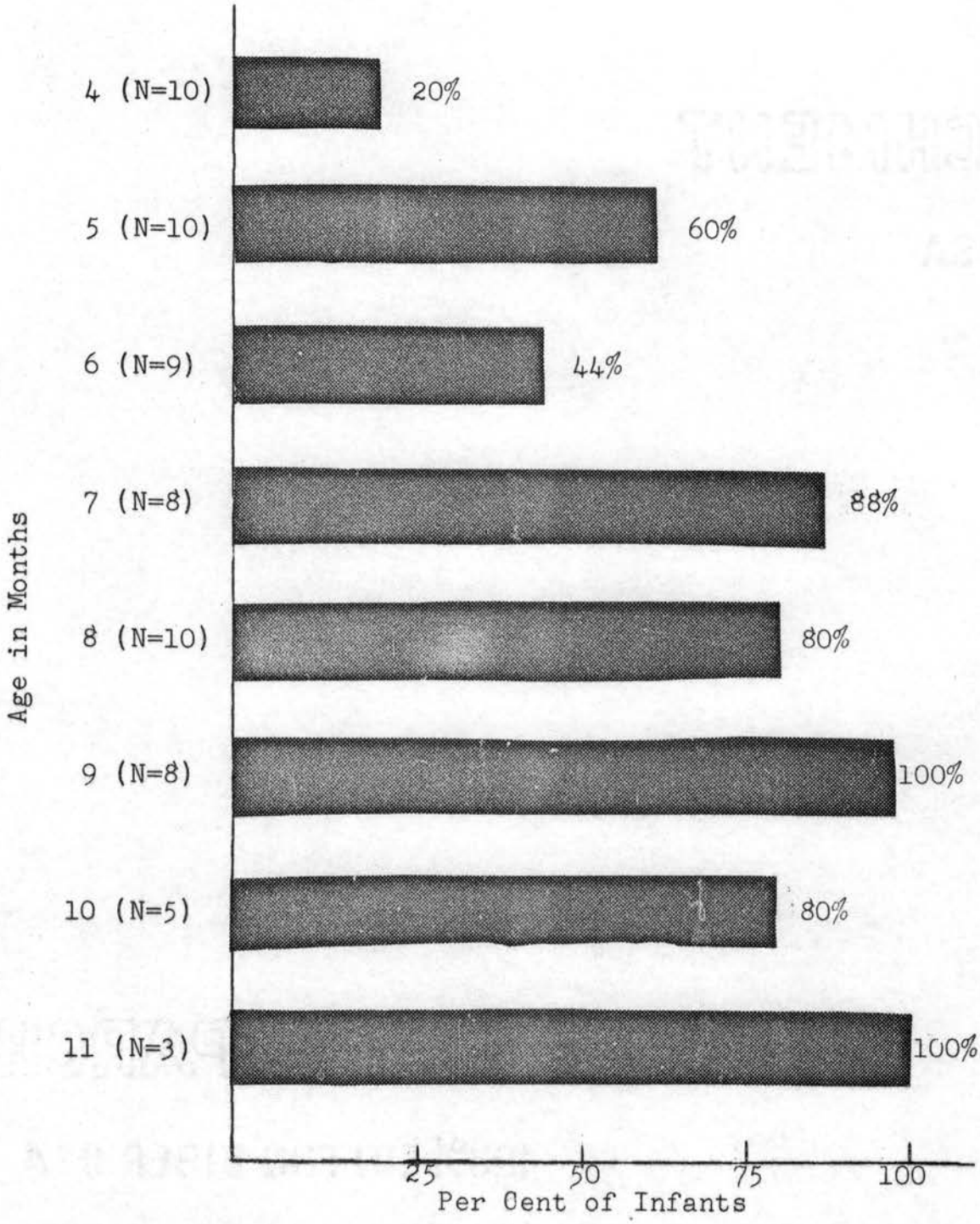

Figure 3. Per cent of infants in each age group showing form preferences. (N=63)

Generalizations

Concept of Relative Size

Scores showing a preference for larger or smaller objects are accepted as indicative of generalization ability based on the concept of relative size. The infants' responses to the test for size preferences (Set II) were used to figure these scores. Of the 71 infants tested, 31 showed this ability to generalize. The data presented by age groups in Table V indicate that younger infants prefer objects of larger relative size; and preference for objects of smaller relative size begins to appear at nine months of age. The per cent of infants in each age group showing concepts of relative size is graphically represented in Figure 4.

TABLE V

CONCEPT OF RELATIVE SIZE AS INDICATED BY INFANTS' PREFERENCES FOR LARGER AND SMALLER OBJECTS (N=71)

Relative Size	Age in Months					Total
	4-5	6-7	8-9	10-11	12+	
Larger	8	11	4	3	0	26
Smaller	0	0	1	3	1	5
Number of Infants	20	17	18	8	8	71
Number Showing Preferences	8	11	5	6	1	31

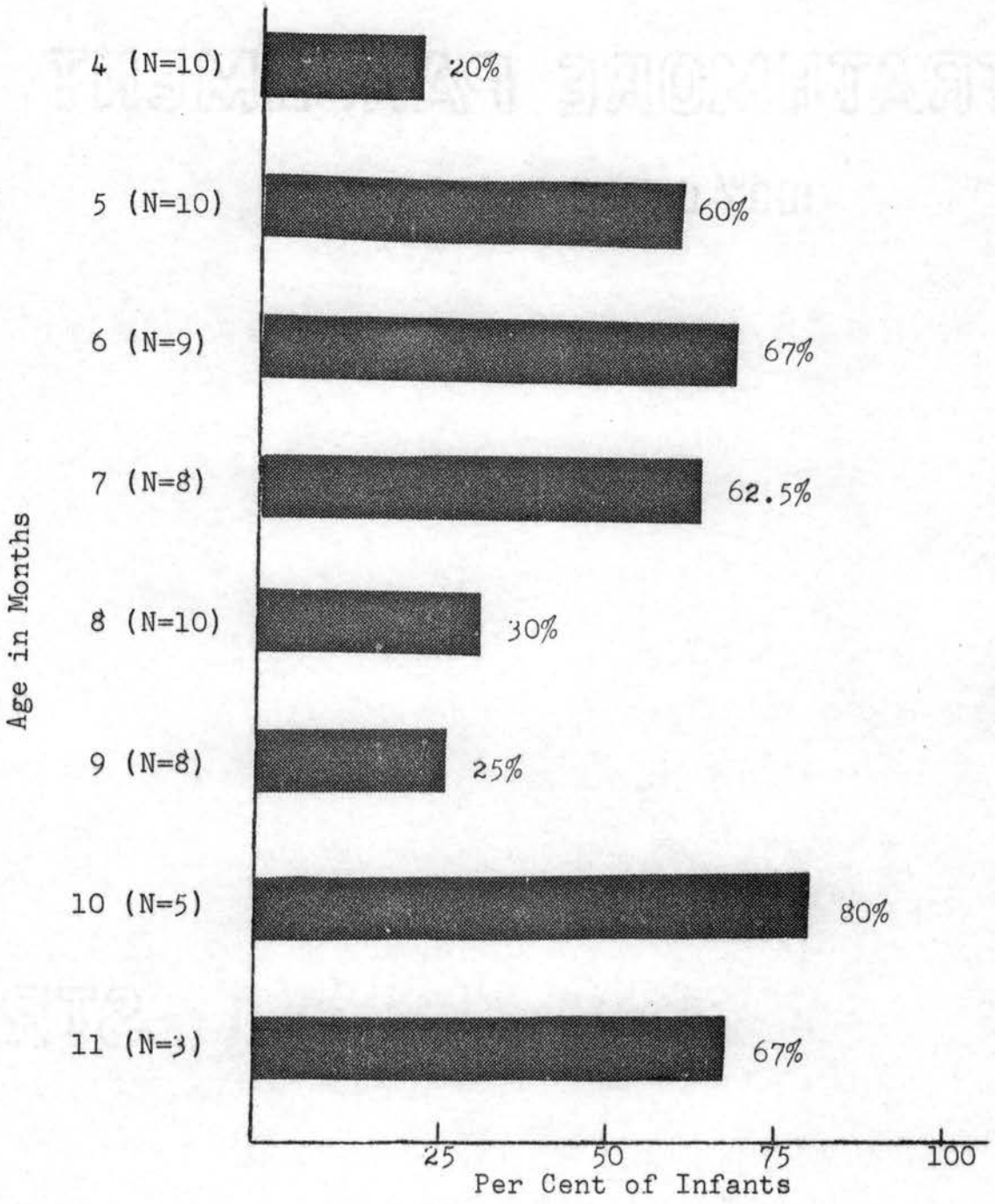

Figure 4. Per cent of infants in each age group showing concepts of relative size. (N=63)

Concept of Roundness

Scores showing a preference for flat circles and spheres are accepted as indicative of generalization ability based on the concept of roundness. The infants' responses to the test for form preferences (Set III) were used to figure these scores. Of the 63 infants under one year of age who were tested, 15 showed this ability to generalize. The per cent of infants in each age group showing a concept of roundness is graphically represented in Figure 5. This concept was first evident at seven months and was demonstrated by most of the older infants.

A preference for spheres regardless of color or size is also evidence of generalization, according to the definition used in this research. Set IV of the research instrument, specifically designed to measure this ability to generalize, was administered to the 28 infants who had shown a preference for spheres on the form preference test (Set III). Of these, 22 infants showed generalization based on a concept of spheres. Unlike the concept of roundness, which first appeared at age seven months, the concept of spheres first appeared at age four months.

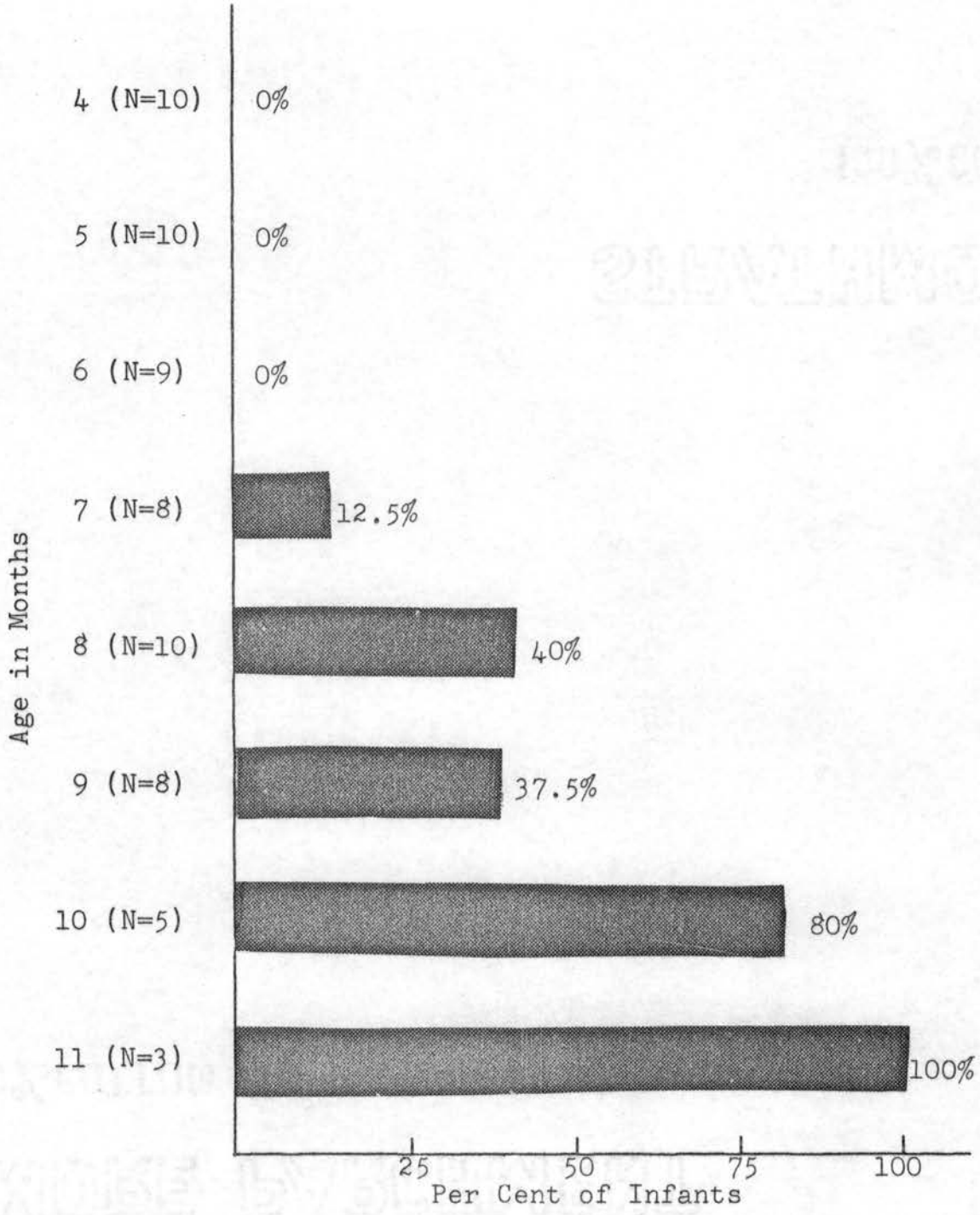

Figure 5. Per cent of infants in each age group showing a concept of roundness as indicated by a preference for spheres and flat circles. (N=63)

The Relationship of Preferences to Age

A graphic comparison of color, size, and form preferences by age is presented in Figure 6. For the young infants color preference was predominant and showed a gradual decrease after five months of age. Size preference was fairly constant from five months through nine months of age and was shown by all of the older infants tested. Where size is concerned, the reader will recall that the younger infants preferred large objects and the older infants began to show a preference for the smaller objects. Form preference showed an irregular pattern of increase from five months through eleven months of age and was shown by most of the older infants.

The Relationship of Generalization Ability to Age

A graphic comparison of infants' ability to generalize based on the concept of relative size and the concept of roundness is presented in Figure 7. The ability to generalize based on the concept of relative size was shown by infants as young as four months of age. Changes in this ability from one month to the next were irregular with a noticeable decrease occurring at eight and nine months, which is the age at which preferences for small objects first appeared in the test of size preferences (Set III).

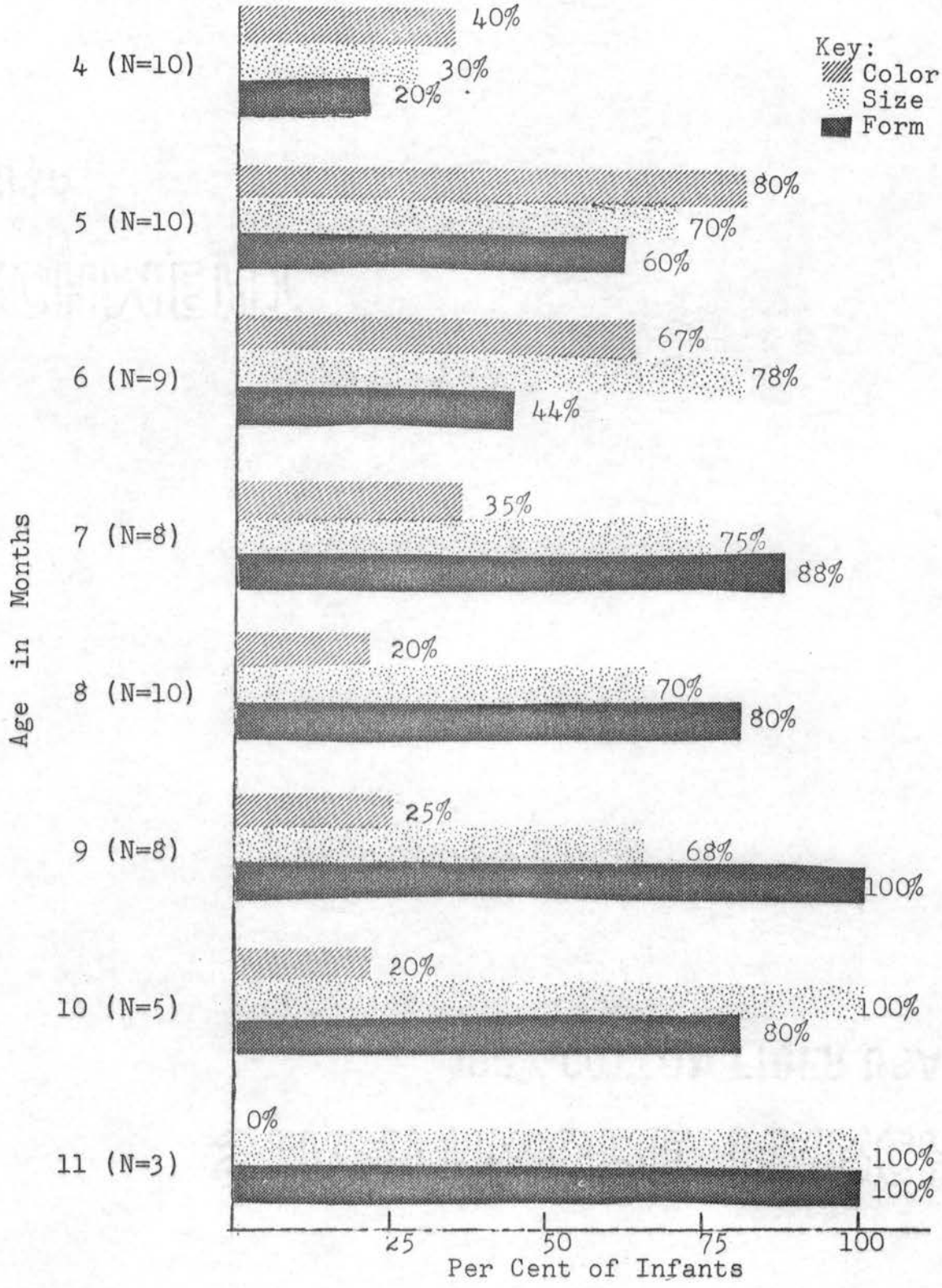

Figure 6. Per cent of infants in each age group showing color, size, and form preferences. (N=63)

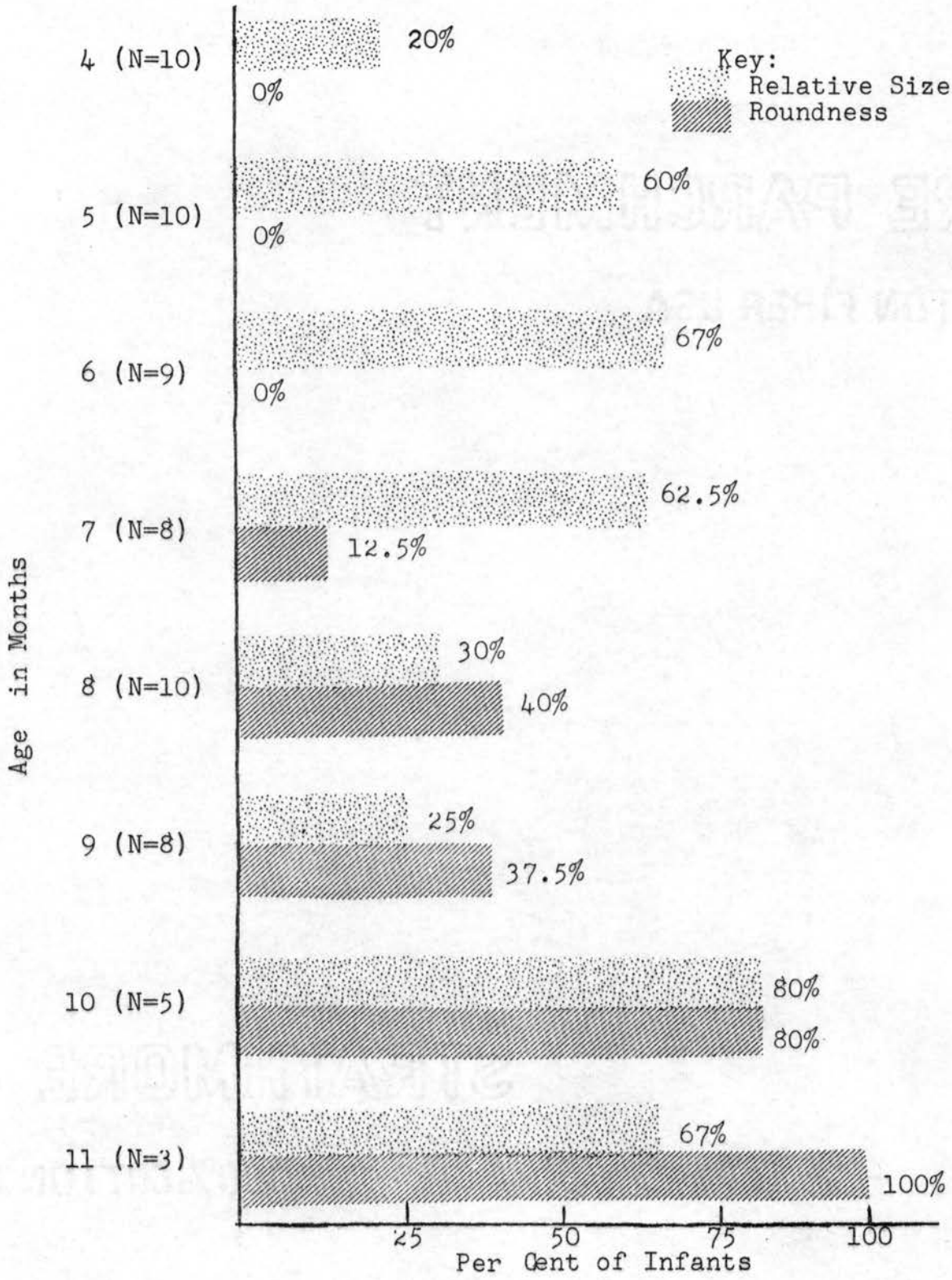

Figure 7. Per cent of infants in each age group showing generalization ability based on the concept of relative size and the concept of roundness. (N=63)

The ability to generalize based on the concept of roundness was not shown by infants younger than seven months and showed a rather steady increase with age.

Summary

The present study was an exploration of young infants' preferences for color, size, and form, and their ability to generalize. The responses of the infants who participated in this study indicated that color, size, and form preferences are shown by some infants as young as four months of age, and that color preferences seem to decrease with age, whereas size and form preferences tend to increase. Size preferences seem to shift from preference for large objects to preference for smaller objects.

The ability to generalize, based on a concept of relative size, appears as early as four months of age; and the ability to generalize based on a concept of roundness appears as early as seven months of age.

CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of this research was to examine infants' responses to visual stimuli for evidence of color, size, and form preferences, for evidence of generalization, and for evidence of changes which may occur with increased maturity. An instrument was developed and administered to 71 infants ranging in age from four months through 17 months.

The instrument was composed of five sets of paired styrofoam objects. Sets I and V consisted of objects of five different colors and were designed to reveal color preferences. Set II consisted of objects of five different sizes, and was designed to reveal size preferences and generalization based on the concept of relative size. Set III consisted of five different forms and was designed to reveal form preferences and generalization based on the concept of roundness. Set IV consisted of spheres paired with other forms and was designed to test generalization based on the concept of spheres.

The infants were shown one pair of objects at a time. Any reaching motion toward an object, with or without

was accepted as a positive response to that object. The raw scores for each infant consisted of a numerical count of the positive responses made to each of the various objects in the total research instrument. These raw scores were used to determine the presence or absence of preference for colors, sizes, and forms. From these raw scores were derived the scores for generalization based on the concept of relative size and generalization based on the concept of roundness.

The responses of the infants indicated that color, size, and form preferences are shown by some infants as young as four months of age, and that color preferences seem to decrease with age, whereas size and form preferences tend to increase. Size preferences seem to shift from preference for large objects to preference for smaller objects.

The ability to generalize based on a concept of relative size appears as early as four months of age, and the ability to generalize based on a concept of roundness appears as early as seven months of age.

Implications for Future Research

As an exploratory study this investigation raised questions and indicated areas in which more intensive research would be advisable.

1. The present investigation revealed that infants as young as four months of age have color preferences and are able to generalize. This suggests that preferences and generalization ability of infants younger than four months of age should be investigated.

2. Most of the infants over one year of age showed little interest in the tasks. Also, the infants who were completely secure when sitting independently began to show the simultaneous grasping with two hands described by Waring (circa 1927). These observations indicate that a different research instrument is needed for use with older infants in the study of generalization ability.

3. Color preferences were examined in the present research, but generalization based on the concept of color was not tested. This type of study should be included in future research.

4. A more intensive study of generalization based on the concept of roundness seems feasible. The present results were rewarding but inadequate.

5. A more intensive study of size preferences and generalization based on the concept of relative size is indicated. The older infants in this study made an apparent shift from preference for large objects to a preference for smaller objects, but the small number of older infants tested made these findings inconclusive.

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APPENDIX A

DESCRIPTION OF THE RESEARCH INSTRUMENT

The research instrument consisted of five sets of paired styrofoam objects. For each of the five sets, a description of the objects and their position in each pair and the order of presentation of the pairs are listed below.

Set I: Color Preferences
All objects: 1" cubes

1.	Black	Red	11.	Blue	Green
2.	Blue	Green	12.	Black	Red
3.	Yellow	Black	13.	Yellow	Blue
4.	Blue	Red	14.	Green	Black
5.	Green	Yellow	15.	Red	Yellow
6.	Black	Blue	16.	Black	Blue
7.	Red	Green	17.	Green	Yellow
8.	Yellow	Blue	18.	Blue	Red
9.	Green	Black	19.	Yellow	Black
10.	Red	Yellow	20.	Red	Green

Set II: Size Preferences and Generalization
Concept of Relative Size

	Size of Cubes		Color
1.	3/4"	1"	Blue
2.	1¼"	1½"	Green
3.	1 3/4"	3/4"	Green
4.	1¼"	1"	Blue
5.	1½"	1 3/4"	Blue
6.	3/4"	1¼"	Green
7.	1"	1½"	Green
8.	1 3/4"	1¼"	Blue
9.	1½"	3/4"	Blue
10.	1"	1 3/4"	Green
11.	1¼"	1½"	Green
12.	3/4"	1"	Blue
13.	1 3/4"	1¼"	Blue
14.	1½"	3/4"	Green
15.	1"	1 3/4"	Green
16.	3/4"	1¼"	Blue
17.	1½"	1 3/4"	Blue
18.	1¼"	1"	Green
19.	1 3/4"	3/4"	Green
20.	1"	1½"	Blue

Set III: Form Preferences and Generalization
Concept of Roundness

Spheres: $1\frac{1}{2}$" in diameter
Cubes: $1\frac{1}{4}$"
Rectangles: 1" x 1" x $2\frac{1}{2}$"
Triangles: 2" in height; 1" in depth
Flat Circles: 2" in diameter; 1" in depth

	Forms of Objects		Color
1.	Sphere	Cube	Blue
2.	Rectangle	Triangle	Green
3.	Flat Circle	Sphere	Green
4.	Rectangle	Cube	Blue
5.	Triangle	Flat Circle	Blue
6.	Sphere	Rectangle	Green
7.	Cube	Triangle	Green
8.	Flat Circle	Rectangle	Blue
9.	Triangle	Sphere	Blue
10.	Cube	Flat Circle	Green
11.	Rectangle	Triangle	Green
12.	Sphere	Cube	Blue
13.	Flat Circle	Rectangle	Blue
14.	Triangle	Sphere	Green
15.	Cube	Flat Circle	Green
16.	Sphere	Rectangle	Blue
17.	Triangle	Flat Circle	Blue
18.	Rectangle	Cube	Green
19.	Flat Circle	Sphere	Green
20.	Cube	Triangle	Blue

Set IV: Generalization
Concept of Spheres

	Form of Objects		Size	Color
1.	Sphere	Triangle	1¼"	Blue
2.	Cube	Sphere	1"	Yellow
3.	Triangle	Sphere	1¼"	Black
4.	Sphere	Cube	1"	Green
5.	Sphere	Cube	1"	Red
6.	Triangle	Sphere	1¼"	Yellow
7.	Cube	Sphere	1¼"	Blue
8.	Sphere	Cube	1¼"	Black
9.	Sphere	Triangle	1"	Red
10.	Cube	Sphere	1"	Green

Set V: Color Preferences

This set was designed for infants older than six months of age and was identical to Set I except that the objects were one-inch spheres rather than one-inch cubes.

APPENDIX B

RAW DATA

The scores for the individual infants tested are shown in Tables VI and VII. The following legend applies to both of these tables.

Legend: Tables VI and VII

- \- No response or no preference
- x Preference shown
- O No testing on this task

Sets I and V: Color preferences

A - Black
B - Red
C - Blue
D - Green
E - Yellow

Set II: Size preferences and generalization
Concept of relative size

A - 3/4" cube
B - 1" cube
C - 1¼" cube
D - 1½" cube
E - 1 3/4" cube

Set III: Form preferences and generalization
Concept of roundness

A - Sphere
B - Cube
C - Rectangle
D - Triangle
E - Flat Circle

TABLE VI

AGE, SEX, AND RAW SCORES OF INDIVIDUAL CHILDREN PARTICIPATING IN AN EXPLORATORY STUDY OF INFANTS' ABILITY TO GENERALIZE
(N=71)

Code Number-Sex	Age in Months	Preference Sets: Sets I and V (Color) A	B	C	D	E	Set II (Size) A	B	C	D	E	Set III (Form) A	B	C	D	E
715-F	4.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
716-F	4.2	3	4	3	3	7	4	4	3	6	3	6	2	3	3	6
717-M	4.2	7	2	3	4	2	-	-	-	-	-	-	-	-	-	-
718-M	4.4	5	1	4	4	5	-	-	-	-	-	-	-	-	-	-
719-M	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
720-M	4.4	4	4	4	4	4	-	-	-	-	-	-	-	-	-	-
728-F	4.5	7	4	3	3	3	-	-	-	-	-	-	-	-	-	-
721-F	4.5	-	-	-	-	-	1	3	3	6	7	4	6	4	2	2
722-F	4.7	6	4	4	3	3	-	-	-	-	-	-	-	-	-	-
723-M	4.7	5	3	4	4	4	1	4	5	3	7	-	-	-	-	-

TABLE VI (CONTINUED)

Number-Sex	Age in Months	Sets I and V (Color)					Set II (Size)					Set III (Form)				
		A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
724-F	5.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
725-M	5.2	2	5	5	6	2	-	-	-	-	-	-	-	-	-	-
726-M	5.2	6	5	1	2	6	3	2	3	4	8	7	1	5	3	4
727-M	5.3	3	6	2	5	4	1	4	2	5	7	-	-	-	-	-
728-F	5.4	5	4	5	2	4	2	1	3	7	7	3	8	2	2	5
729-F	5.6	7	1	7	3	2	1	3	3	6	7	1	4	7	3	4
730-M	5.6	6	5	3	1	5	-	-	-	-	-	-	-	-	-	-
723-M	5.8	4	6	0	4	5	4	2	4	4	6	7	1	1	2	4
731-M	5.8	5	6	3	3	3	2	3	3	4	8	8	1	4	2	3
732-M	5.9	4	7	4	1	4	0	3	5	5	7	6	4	8	0	2
733-F	6.0	4	3	4	4	5	2	3	4	6	4	2	2	4	6	6
726-M	6.2	2	7	5	3	3	5	1	3	3	8	6	3	3	3	5
734-F	6.3	4	4	5	3	4	-	-	-	-	-	-	-	-	-	-

TABLE VI (CONTINUED)

Number-Sex	Age in Months	Sets I and V (Color)					Set II (Size)					Set III (Form)				
		A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
735-M	6.3	0	5	5	4	6	2	2	4	4	8	2	6	3	5	4
736-F	6.5	3	4	6	4	3	2	1	5	4	8	6	6	2	0	6
737-M	6.8	7	3	1	6	3	1	5	3	4	7	4	4	5	2	5
732-M	6.8	4	4	4	3	4	3	0	4	8	5	5	2	4	2	4
725-M	6.8	7	4	2	2	4	-	-	-	-	-	-	-	-	-	-
738-F	6.9	3	5	3	2	7	0	3	3	6	8	5	3	4	3	4
739-F	7.1	5	6	3	2	3	1	2	5	6	6	3	1	8	3	4
740-M	7.3	3	7	3	3	4	3	1	5	5	6	7	1	4	3	5
741-F	7.3	3	4	5	3	5	2	4	4	6	4	6	6	3	1	4
742-M	7.4	5	3	4	5	3	3	4	2	5	6	6	2	4	2	5

TABLE VI (CONTINUED)

Number-Sex	Age in Months	Sets I and V (Color)					Set II (Size)					Set III (Form)				
		A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
743-M	7.5	5	3	3	6	3	0	2	4	6	8	7	3	3	2	5
734-F	7.6	3	6	2	3	6	4	4	4	4	4	5	2	3	2	8
744-M	7.9	7	4	2	3	4	1	2	5	5	7	6	0	5	3	6
745-M	7.9	2	4	5	5	4	3	1	5	5	3	-	-	-	-	-
748-M	8.0	3	6	4	4	3	2	4	4	2	6	8	1	3	3	5
737-M	8.0	3	5	6	2	4	2	5	4	4	5	-	-	-	-	-
749-F	8.1	4	5	3	5	3	5	3	2	6	4	7	1	4	4	4
751-F	8.3	-	-	-	-	-	6	5	2	5	2	8	3	3	1	5
750-F	8.4	3	4	4	4	5	3	3	3	4	7	7	0	5	3	5
752-F	8.6	3	4	4	4	5	3	6	3	4	4	4	0	6	6	4
753-F	8.6	3	3	4	5	4	5	4	5	4	6	5	4	1	5	5
754-F	8.7	2	4	5	4	5	2	0	5	7	6	5	2	3	2	8

TABLE VI (CONTINUED)

Number-Sex	Age in Months	Sets I and V (Color)					Set II (Size)					Set III (Form)				
		A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
755-M	8.8	4	5	4	4	3	4	3	4	5	4	8	2	1	3	6
756-F	9.0	2	3	2	7	5	5	2	2	4	7	8	1	3	3	5
771-F	9.2	3	3	2	3	7	5	3	2	5	4	7	0	4	2	4
748-M	9.2	3	3	3	2	4	0	3	5	6	6	7	3	1	2	7
746-M	9.5	3	5	3	4	5	4	4	4	4	4	6	4	2	4	4
752-F	9.5	5	4	4	2	5	4	2	2	6	6	4	1	7	4	4
749-F	9.6	-	-	-	-	-	3	5	3	2	7	6	3	3	2	6
745-M	9.6	-	-	-	-	-	4	2	4	5	5	7	3	4	3	3
753-F	9.8	-	-	-	-	-	6	6	4	3	1	7	4	2	1	6
757-F	10.0	6	4	3	3	4	5	6	5	0	4	8	2	1	3	6
770-M	10.1	-	-	-	-	-	7	4	4	3	2	6	3	3	1	7

TABLE VI (CONTINUED)

Number-Sex	Age in Months	Sets I and V (Color)					Set II Size)					Set III (Form)				
		A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
756-F	10.2	4	4	4	4	4	7	4	3	2	4	8	3	3	0	6
758-F	10.3	4	4	2	5	4	3	1	4	4	7	4	2	5	4	5
759-F	10.9	-	-	-	-	-	2	2	6	6	4	7	2	2	2	7
760-F	11.0	3	4	3	3	4	0	4	3	6	7	7	2	2	3	6
761-F	11.2	3	5	4	5	3	2	2	4	5	7	7	3	2	1	7
759-F	11.9	4	4	4	4	4	3	2	3	5	7	8	3	2	1	6
762-M	12.3	3	4	4	4	5	5	3	3	4	5	7	2	1	3	7
765-M	13.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
766-M	13.5	5	3	3	7	2	6	4	2	3	1	6	2	0	2	7
767-F	13.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

TABLE VI (CONTINUED)

Number-Sex	Age in Months	Sets I and V (Color)					Set II (Size)					Set III (Form)				
		A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
764-M	13.6	4	4	2	3	6	3	3	4	5	4	8	2	1	2	6
763-M	13.9	5	4	3	3	5	-	-	-	-	-	6	1	3	2	7
768-M	14.7	2	3	6	5	4	-	-	-	-	-	-	-	-	-	-
769-F	17.8	4	3	5	4	3	6	3	4	3	3	7	1	2	3	7

TABLE VII

AGE, SEX, AND DERIVED SCORE OF THE INDIVIDUAL CHILDREN PARTICIPATING IN AN EXPLORATORY STUDY OF INFANTS' ABILITY TO GENERALIZE
(N=71)

Number-Sex	Age in Months	Preferences			Generalization Scores			
					Concept of Relative Size			
		Color	Size	Form	Larger	Smaller	Concept of Roundness	Concept of Spheres (Set IV)
715-F	4.0	-	-	-	-	-	-	-
716-F	4.2	x	x	x	10	10	10	9
717-M	4.2	x	-	-	-	-	-	-
718-M	4.4	-	-	-	-	-	-	-
719-M	4.4	-	-	-	-	-	-	-

TABLE VII (CONTINUED)

Number-Sex	Age in Months	C	S	F	L	S	R	S
720-M	4.4	-	-	-	-	-	-	-
721-F	4.5	-	x	x	18	2	4	-
728-F	4.5	x	-	-	-	-	-	-
722-F	4.7	x	-	-	-	-	-	-
723-M	4.7	-	x	-	14	6	-	-
724-F	5.2	-	-	-	-	-	-	-
725-M	5.2	x	-	-	-	-	-	-
726-M	5.2	x	x	x	15	5	9	0
727-M	5.3	x	x	-	15	4	-	-
728-F	5.4	-	x	x	18	2	6	-

TABLE VII (CONTINUED)

Number-Sex	Age in Months	C	S	F	L	S	R	S
729-F	5.6	x	x	x	16	4	3	-
730-M	5.6	x	-	-	-	-	-	-
723-M	5.8	x	x	x	10	10	9	-
731-M	5.8	x	x	x	17	3	9	8
732-M	5.9	x	x	x	18	2	6	7
733-F	6.0	-	x	x	11	8	6	-
726-M	6.2	x	x	x	14	6	9	8
734-F	6.3	-	-	-	-	-	-	-
735-M	6.3	x	x	x	15	5	4	-
736-F	6.5	x	x	x	17	3	10	5
737-M	6.8	x	x	-	16	4	7	-

TABLE VII (CONTINUED)

Number-Sex	Age in Months	C	S	F	L	S	R	S
732-M	6.8	-	x	-	15	5	7	-
725-M	6.8	x	-	-	-	-	-	-
738-F	6.9	x	x	-	19	1	7	-
739-F	7.1	x	x	x	16	4	5	-
740-M	7.3	x	x	x	14	6	10	0
741-F	7.3	-	x	x	12	8	8	0
742-M	7.4	-	x	x	14	6	9	0
743-M	7.5	x	x	x	20	0	10	5
734-F	7.6	x	-	x	8	12	11	7
744-M	7.9	x	x	x	16	4	10	6
745-M	7.9	-	-	-	9	8	-	-

TABLE VII (CONTINUED)

Number-Sex	Age in Months	C	S	F	L	S	R	S
748-M	8.0	x	x	x	13	7	11	7
737-M	8.0	x	-	-	12	8	-	-
749-F	8.1	-	x	x	12	8	9	0
747-M	8.2	-	-	x	10	10	8	5
751-F	8.3	-	x	x	7	13	11	9
750-F	8.4	-	x	x	16	4	10	10
752-F	8.6	-	x	x	8	12	6	-
753-F	8.6	-	x	-	10	10	8	-
754-F	8.7	-	x	x	15	5	11	8
755-M	8.8	-	-	x	12	8	12	8
756-F	9.0	x	x	x	13	7	11	10
771-F	9.2	x	-	x	9	11	9	7

TABLE VII (CONTINUED)

Number-Sex	Age in Months	C	S	F	L	S	R	S
748-M	9.2	-	x	x	17	3	12	10
746-M	9.5	-	-	x	8	12	8	8
752-F	9.5	-	x	x	11	9	6	-
745-M	9.6	-	-	x	10	10	8	10
749-F	9.6	-	x	x	13	7	10	9
753-F	9.8	-	x	x	5	15	11	8
757-F	10.0	x	x	x	6	14	12	5
770-M	10.1	-	x	x	5	15	11	8
756-F	10.2	-	x	x	5	15	12	9
758-F	10.3	-	x	-	15	4	7	-
759-F	10.9	-	x	x	12	8	12	9

TABLE VII (CONTINUED)

Number-Sex	Age in Months	C	S	F	L	S	R	S
760-F	11.0	-	x	x	18	2	11	7
761-F	11.2	-	x	x	16	4	12	0
759-F	11.9	-	x	x	13	7	12	10
762-M	12.3	-	-	x	12	8	12	0
765-M	13.5	-	-	-	-	-	-	-
766-M	13.5	x	x	x	3	13	11	9
767-F	13.5	-	-	-	-	-	-	-
764-M	13.6	x	-	x	11	8	12	9
763-M	13.9	-	-	x	-	-	11	10
768-M	14.7	x	-	-	-	-	-	-
769-F	17.8	-	x	x	10	10	12	6

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