EFFECTS OF PERCEPTUAL TRAINING ON CHILDREN'S DRAWINGS OF FAMILIAR OBJECTS WITH DISTINCTIVE FEATURES

by

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I hereby recommend that this dissertation prepared under my direction by JOAN SHEEKS WYDE

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As members of the Final Examination Committee, we certify that we have read this dissertation and agree that it may be presented for final defense.

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Final approval and acceptance of this dissertation is contingent on the candidate's adequate performance and defense thereof at the final oral examination.

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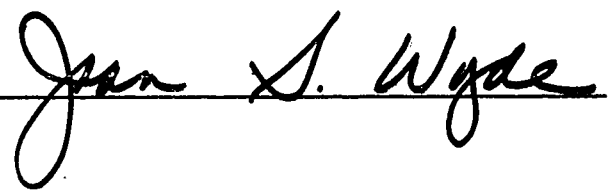
SIGNED: 

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ABSTRACT

The effects of verbal discrimination training on children's developing ability to accurately draw concrete objects with certain defining (characteristics essential to the concept of the object) and nondefining (nonfunctional decorations) features was evaluated through analysis of their scores on posttest measures. Subjects were young children, age three years eight months to six years six months, who did not draw veridically on pretest screening tests. Training for the experimental group consisted of increasingly specific verbal instructions, designed to call attention to the perceptual aspects of the viewed objects, and further practice in drawing the objects correctly. Results indicated that training was effective in increasing children's ability to draw veridically. There was no difference between males and females in their responses to training although a difference was found to exist between younger and older children. Additional behaviors dealing with motor ability, labeling response and visual response were observed.

CHAPTER 1

INTRODUCTION

Children sometimes behave in ways that adults assume are due either to children's limited abilities or children's inability to respond as an adult would within a given situation. Children's responses therefore have sometimes been simply accepted without further questioning of the mechanisms or processes involved in those responses. The development of children's graphic responses has in this way been largely ignored by those who would research other areas of children's development.

The lack of scientific information about how children learn to draw has handicapped those who would like to encourage children in their artistic and creative efforts as well as certain aspects of learning to write. With the present stress upon full development of individual potential it is time to investigate aspects of graphic development more systematically.

In this study graphic skill was identified as an important and common aspect of children's representational ability and questions of how children graphically represent common objects with certain distinctive features were explored.

Literature Review

A fairly well established tradition in cognitive psychology concerning children's graphic representation of external stimuli is that children "draw what they know and not what they see" (Clark 1897, Luquet 1927, Piaget and Inhelder 1956 and Eng 1959). This somewhat simplistic view has often been accepted without further questioning of the cognitive or perceptual mechanisms involved in the phenomenon. However, a number of authors have sought further definition of the processes involved in the act of graphically copying a stimulus. Motor ability, perceptual ability and cognitive ability have been delineated as the most important elements in the process.

Motor Ability

Motor ability is inherent in any task of graphic skill. Motor ability has been consistently shown as relevant to the normal child's graphic performance but not the totality of it. Researchers working with children between the ages of three and nine have found that all but the youngest children possess enough motor control to perform the required tasks (Piaget and Inhelder 1956, Lovell 1959, Maccoby and Bee 1965 and Olson 1968).

Perceptual Ability

Perceptual development has been established as an important element in copying tasks. However, it is evident from several sources that a young child is readily able to perceive differences that he fails to exhibit when graphically copying stimuli, although accuracy increases with age (Bee and Walker 1968, Maccoby 1968 and Brittain 1969). In this regard, Graham, Berman and Ernhart (1960) found that children's ability to produce number of attributes correctly also increased in a linear fashion with age.

Maccoby and Bee (1965) have presented several hypotheses to explain this "lag" between the ability to perceive and perform. Their first hypothesis was that perhaps the child guides his own recognition and production of words and visual forms by his own idiosyncratic cues. However, Maccoby and Bee found that children had no more recognition of their own distorted speech or their own misproduced drawings than they did of other children's. Brittain (1969) found this same phenomenon in training children to draw squares. Apparently whatever cues children use when copying are not utilized to identify the copy itself.

Maccoby and Bee's second hypothesis suggested children's lack of motor ability in producing veridical drawings. In a series of experiments partially duplicating Piaget's work some very young children who were able to discriminate

between stimuli could neither draw the stimulus nor recreate it when given its concrete component parts. Although Maccoby saw these two tasks as involving different motor skills the children had no difficulty making the requisite hand and arm movements. The difficulty arose, particularly when reproducing triangles or diamonds, of getting the lines in the proper relationship. It seems as though motor skill is an important element but not sufficient to explain a child's inability to produce accurate copy.

Maccoby and Bee's final hypothesis was a "number of attributes" proposal. It was suggested that children need to differentiate many more attributes of a model when copying it than they must to make perceptual discriminations. Lovell (1959) supported the findings that accurate copying of a form depends on the number of component parts. Denisova (1962) found that preschool children asked to copy simple geometric forms varying in size, shape and color tend to focus on one variable in exclusion of the others. A later study by Maccoby (1968) supported Denisova's observation that a child's more holistic view of the stimuli influences his discriminations. Maccoby (1968) subsequently modified her "numbers of attributes" hypothesis to read, ". . . for discrimination of simple geometric forms, holistic perception suffices, for making copies it does not" (p. 166). Maccoby pointed out that copying requires fractionation of

the perceived stimuli into its component parts and reported an experiment by Goodson (1967) showing that perceptual discrimination of various attributes of a stimuli is a prerequisite for correct coyping. Thus copying activity requires sequentially drawing and putting parts together again. It also entails checking back with the original so as not to lose the relationship between the whole and its parts. Maccoby suggests that this may be the most important part of the task.

Visual analysis, the ability to detect distinctive features (Gibson 1969 and Olson 1970), has been found important in copying behavior and in some studies discrimination training has resulted in improved copies (Goodson 1967, Maccoby 1968 and Brittain 1969). Other studies have shown no relationship between discrimination training and copying abilities (Bee and Walker 1968 and Olson 1968).

Rand (1973) attempted to determine whether accurate visual analysis or learning to utilize drawing rules is more important for copying. Her results indicated that drawing rule utilization resulted in improved copying accuracy but did not improve discrimination. It was also shown that increased improvement in figure discrimination was related to decreased copying accuracy. Rand concluded that drawing rules are more important than discrimination in production of accurate copy.

Olson (1968) reported success with verbally mediated discrimination training. He required children to verbalize a rule about forming diagonals, such as, "They always start from one corner and go to the other." When such perceptual properties were verbally coded they began to influence children's drawing behavior. Olson suggested that the gap between perceiving and performing may partially be filled by the development of ways of representing the perceptions in terms of part-whole relationships or the attributes of the concept.

In summary, the research concerning perceptual processes indicates that:

1. Young children perceive that which they cannot or do not accurately draw but that copying accuracy increases with age.
2. Children must perceive attributes of a stimulus accurately in order to produce accurate drawings.
3. The more attributes of a stimulus the more difficult it is for children to copy.
4. Visual reference to the object and analysis of distinctive features of the object is the key to getting the part-whole relationship correct.
5. Verbal cueing through drawing rules increase graphic copying accuracy as does verbally medicated discrimination training.

Cognitive Ability

The third important process in copying development is cognitive functioning, as discussed by Piaget and Inhelder (1956). Their concern was with mental representation of the stimulus rather than its perception or reproduction. Piaget contended that to recognize a form one must have a preexisting schema of that form which has been built on many repeated encounters with that form. The schema is activated by an appropriate field stimulus. Drawing a form requires children to consider or represent the form in its physical absence by mentally reconstructing the form as a "mental image" or "representational thought." Piaget and Inhelder (1956, p. 33) state:

> In other words the drawing, like the mental image, is not simply an extension of ordinary perception, but rather the combination of the movements, anticipations, reconstructions, comparisons and so on, that accompany perception and which we have called perceptual activity. . . . Like a mental image, a drawing is an internal or external limitation of the object and not just a perceptual photograph.

Piaget found, as did Luquet (1927), that children between the ages of three and seven do not have the level of schema development necessary to produce veridical drawings. Thus Piaget accounts for the lag between perceiving and performing by the need of further development to a new level of representational thought arising from both motor and perceptual activity.

This view is similar to the object constancy hypothesis discussed by Maccoby and Bee (1965). This hypothesis holds that when children look at a stimulus object they see it as only one of many possible views of that object. When children are set the task of copying they simply choose to reproduce the most reasonable likeness of the object rather than the perceived view. There is some support for this stand in the work of Nelson and Bartley (1962), E. J. Gibson (1969) and J. J. Gibson (1950). However, Maccoby and Bee (1965) point out that this hypothesis does not explain why children are able to judge their own drawing as not a good match and that they are able to detect the differences between their own drawing and the model. Piaget's explanation is that children become fixated on only one image or aspect of the object while drawing, that one being the mental image they already possess.

Freeman and Janikoun (1972) tested the role of existing mental images influencing children's drawings. They required children to produce a veridical drawing of a cup presented for viewing when the handle was hidden from view and a design evident. Freeman hypothesized that in order to support Piaget's contention of dominant mental images in young children he should find the younger children including the hidden handle which would be an integral part of their

mental image of cupness, and excluding the flower design which was nonessential to the concept. The reverse would be true for older children.

Freeman's results confirmed Piaget's hypothesis and supported the finding that the change from intellectual realism to visual realism occurred about the age of seven as noted by Piaget. Freeman hypothesized that young children include the handle in their drawing for two reasons; it is part of their mental image and because they think the drawing would be unrecognizable without it.

In summary, cognitive functioning has been delineated as an important element in children's developing ability to produce graphic copy. Levels of mental representation shown in developing schema are age related in that young children, age three to six or seven, focus upon mental images rather than perceptual images while drawing.

Summary

Research into literature dealing with graphic representation in young children has explored aspects of perceptual, cognitive and motor development. Motor development has been shown as a necessary prerequisite for performing the required tasks but is not sufficient to explain all aspects of the results obtained. Perceptual ability has also been shown as a prerequisite to accurate performance. Children must be able to differentiate distinctive features of

stimuli before they are able to draw the stimuli correctly. Visual reference to the object is therefore essential in accurate drawings. The more characteristics of the stimuli to be differentiated the more difficult the drawing task. As age increases accuracy of drawing increases although it has been consistently shown that young children perceive that which they cannot or do not draw accurately. Verbal cueing through drawing rules increases copying accuracy as sometimes does discrimination training.

Cognitive functioning has been proposed as a reason for the lag between children's ability to perceive and perform. It has been stated that children tend to focus upon existing mental images of objects when asked to draw such objects and not upon their perceptual images. The age at which such intellectual realism gives way to visual realism seems to be about seven or eight.

Pilot Studies

Several pilot studies were conducted to explore some of the findings summarized in this literature review. The three pilot studies undertaken addressed motor skill, graphic responses exhibited by age, and response to discrimination training in young children.

The first pilot study was conducted with a group of sixteen children (8 male, 8 female) who were enrolled in a Tucson, Arizona church-run preschool and elementary school

that catered to many university families. All the children were white and all had had some previous school experience. The ages ranged from four years three months to eight years seven months. Individually the children were asked to draw a figure of a man and a cup from memory to test their motor abilities and pre-existing mental image of a cup. The children were then asked to draw an actual cup that was placed in front of them at eye level with the handle hidden from view and a flower design showing. If they did not produce an accurate drawing they were given verbal cues until the image was drawn correctly.

Results showed that all the children were capable of drawing the figures required of them and there was no difficulty with motor ability. All of the children drew from memory a recognizable cup including a handle. No child spontaneously drew a design on the cup. Five of the children, ages five years zero months to eight years seven months drew the actual cup correctly on their first attempt, indicating that children younger than previously thought possess the ability to draw veridically. Six of the children took only one training trial to produce an accurate drawing. These findings indicated a need for a more extensive and controlled pilot study to establish age limits and experimental procedure.

The second pilot study was undertaken with 29 children: ages four years zero months to five years ten months; male and female; roughly equal percentages of white, black and Spanish surnamed children in Houston, Texas. The parents of these children worked, and the school was commercially run. Due to questions arising from the first pilot study the children were tested with a series of three common objects which had both defining and nondefining distinctive features. Children were tested individually with the three objects, drawing one after another. If the children drew too of the three objects correctly then they were said to possess the skill of drawing veridically and were returned to their classroom. The children who failed this test were trained through a verbal discrimination procedure until they mastered the task of drawing the objects correctly.

Twenty of the 29 students (71%) drew at least two of the pretest items correctly on the first try. Five other students refused to complete the sequence after training. The last four students took an average of 3.5 training trials to produce accurate copy, or in other words one further trial per object.

The third pilot study was run so as to include lower class children (ages four years three months to six years one month) who had had little or no previous school

experience. The study included 23 black male and female preschoolers in a government-sponsored center in Houston, Texas. The number of test items was expanded to include three screening objects upon which training also took place and five other common objects used for posttesting. Children were again tested individually in the same manner as previously stated.

Fifteen of the 22 children (68%) drew at least two of the three screening test items correctly. Two children refused to continue after training with the posttest items. Four other children did not complete the posttest sequence. Only one child completed all the tasks.

The results of the third pilot showed that young children did draw veridically or could be trained to do so. However, a fatigue factor was evidenced in the children who entered training.

The pilot series also yielded several other interesting findings:

1. There were no differences indicated between the average performance of white and black children.
2. A few Spanish only speakers readily grasped the task required of them.
3. Almost every child visually referred back to the object while drawing. The research literature had indicated this as essential to the task but had also indicated young children did not do so.

4. In fifteen of the 65 pilot cases (23%) children drew only the distinctive design, to the exclusion of any cup whatsoever. This was only true with the initial cup and no other object.

The pilot tests resulted in decisions which were subsequently incorporated in the procedure described in Chapter 2. They were:

1. Experimental children should be under the age of seven so they will not all have the skill and over the age of three so their attention can be held.
2. No pretest of motor ability is necessary.
3. No explanation should be given to the children at any time about the tasks demanded of them.
4. Children who were trained needed a short break between training and posttesting or they became too tired to complete the sequence.
5. The screening procedure should be utilized so that an experimental group who did not already possess the skill to be trained could be obtained.
6. The instructional or training variable was chosen as a focus for the main thrust of further research in conjunction with the demographic variables of sex and age.

Summary

A number of points become of apparent importance after a review of the literature and completion of the pilot studies dealing with graphic copying. Age, perceptual analysis and discrimination, and pre-existing mental images have been found to influence children's graphic responses.

Many authors support the finding that children go through age-related stages in their graphic development (Clark 1897, Luquet 1927, Piaget and Inhelder 1956, Eng 1959, Kellogg 1967, Brittain 1969 and Freeman and Janikoun 1972). Some authors feel that this development is characterized by changes in cognitive functioning which limit children's responses to graphic copying tasks at various ages (Clark 1897, Luquet 1927, Piaget and Inhelder 1956, Eng 1959 and Freeman and Janikoun 1972). One change has been said to occur about the age of seven to eight when children move from intellectual realism, (bringing details into proper relationship) to visual realism (when drawings become accurate and in proper perspective). However, in three pilot studies conducted to test this age response, results indicated that many children have this skill by the age four or five or can be trained to draw veridically by this age.

Perceptual ability, visual discrimination and analysis of perceived stimuli are necessary for accurate reproduction in drawing (Brittain 1969, Maccoby 1968, Gibson

1969, Olson 1970 and Goodson 1967). Some authors support the thesis that young children do not pay attention to direct perceptual images but prefer to draw from memory or mental image the concrete objects presented to them (Piaget and Inhelder 1956, Bee and Walker 1968 and Freeman and Janikoun 1972). Pilot studies indicate that many young children already are able to draw stimuli accurately but those who do not, do tend to produce stylistic images of objects.

Discrimination training has proven effective in better drawings for some authors (Kaspar and Schulman 1964, Goodson 1967, Maccoby 1968 and Bee and Walker 1968) and ineffective for at least one other (Brittain 1969). Verbal mediation may in some cases help children to represent the problem in mental coding as well as to focus on the task demands of the experimental situation thus allowing for more accurate performances (Olson 1968 and Rand 1973). In pilot studies, discrimination training through verbal mediation has been shown effective in producing more accurate drawings.

Research Hypothesis

The main research hypothesis explored in this study was:

> Children unable to draw veridically can be trained to do so through a verbally mediated discrimination paradigm.

Two subordinate hypotheses dealt with the propositions that the ability to draw veridically, or to be trained to do so, varies with sex and with age.

CHAPTER 2

METHODS OF PROCEDURE

Research concerning children's graphic development has focused upon the influence of perception and the influence of mental functioning to explain how children approach drawing tasks. Chapter 2 concerns itself with the development of experimental tasks to test this hypothesis, research design, subjects of the study, experimental procedure, scoring procedure, and data analysis.

Experimental Task and Design

Children's mental images are hypothesized to override actual perceptual images until children are about seven or eight years of age. They, therefore are said to draw what is "in their mind" and not what is in front of them. If this hypothesis is indeed true, it should be possible to design a stimulus situation for testing the hypothesis. The stimulus objects for exploration of this phenomenon should have both characteristics which define (characteristics essential to the concept of the object such as a handle of a cup or the hands and face of a clock) and characteristics which are nondefining (nonfunctional decoration, design or trademark). If the hypothesis is true, children should draw

their mental images and not the actual perceived images. This assumption leads to the hypothesis of this study, that such behavior could be modified through verbal discrimination training. Freeman and Janikoun's (1972) experimental task of drawing familiar objects with distinctive features was chosen for this study for various reasons: the children would have long-standing familiarity with the stimulus objects and therefore strong mental images; there would be no dramatic effect caused by unique or unusual objects; scoring of the drawings for errors of omission or commission would be easily accomplished; perceptual task demands could be made increasingly explicit; and, observation of the child's physical movements could be easily made. A simple posttest-only randomized groups experimental design was used.

Subjects

The study was concerned with the graphic development of male and female children between the ages of three and one half to six and one half years. Subjects were chosen to reflect these characteristics.

Choice of sites--Subjects were obtained by total selection of all the children in the preschool classes at three different commercial preschool sites. The sites were widely spaced within Houston, Texas and represented upper-lower to upper-middle class areas.

Demographic characteristics of the complete sample--The initial subject sample before the screening procedure was implemented is described in Table 1.

Table 1. All Sample Subjects By Age and Sex Before Screening

	Age Groups in Years and Months			
	3-8 to 4-6	4-7 to 5-0	5-1 to 6-6	Totals
Males	21	13	15	49
Females	19	16	13	48
Totals	40	29	28	97

Experimental sample--Any child who refused to participate was deleted and replaced. Any child who began the sequence and subsequently refused for any reason to finish was replaced.

After screening procedures were implemented, the experimental sample consisted of 49 subjects (26 males and 23 females) who were randomly assigned to experimental and control conditions. Table 2 shows the composition of these groups by sex, age and assigned condition.

Table 2. Experimental Subjects By Sex, Age and Assigned Condition

	Age Groups in Years and Months			
	3-8 to 4-5 Lower 1/3	4-6 to 4-10 Middle 1/3	4-11 to 6-6 Upper 1/3	Total Total
Control Male	6	3	4	13
Control Female	7	2	2	11
Experimental Male	0	7	6	13
Experimental Female	4	4	4	12
Totals	17	16	16	49

Screening Procedure

Rationale--A screening procedure was used to eliminate from the experiment those children who already possessed the criterion skill and who therefore could not be included in the experimental training and testing procedure.

Procedure--Each child was taken individually from his classroom to an empty classroom or alcove by the experimenter (E). E chatted along the way to put the child at ease. The child was then seated at a small table which was comfortable for him. A pencil and a pad of paper (5X7") were already placed upon the table in front of him. Without any further explanation the child was handed a mug from a box hidden underneath the table and asked, "What is this?"

When the child named the object, E responded with a smile and nod of the head and then placed the object in front of the child, approximately two feet away on top of a plain cardboard box so the object would be about at the child's eye level. The defining feature of the object was turned from the child's view and a nondefining feature was fully evident.

E then said, "Draw the _____ as you see it from where you sit." When the child indicated his drawing was complete by putting his pencil down or by saying he was through, E replaced the drawing paper, put the object away and then handed the child another object. The child was tested with a mug, then a clock and a brush in turn, each with the same question and instructions. E could easily see if any errors of omission or commission were made as the child drew and could score the child's drawing immediately to see if he should be retained or omitted from the study.

In the few instances when extra things were drawn on the paper E asked "What's that?" pointing to the part in question and noted the child's explanation on the paper.

If the child met the criterion (see following sections) on pretesting he was returned immediately to his class with thanks. If the criterion was not met the child was retained and became part of the experimental sample. These children were randomly assigned to either an experimental or control condition. The control condition children

proceeded directly to the posttest; the experimental condition children entered into the training phase and then proceeded to the posttest.

Scoring criterion--One point was given for each correct aspect of the child's drawing. For example, if an object was drawn correctly, that is, the defining feature hidden from view was omitted and the nondefining visible feature included the child received two points. If both features were included, then one mistake would have been made and the child only received one point. If the child included the hidden feature and excluded the visible feature the score was zero. It was therefore only possible to achieve a score of zero, one or two for each drawing.

Screening scoring--A child who had two or more correct drawings upon pretesting was delected from the study. A correct drawing was one in which the object was accurately represented and obtained a score of two. The distinctive and nondefining feature must have been included and the hidden defining feature must have been excluded. See Appendix A for examples of children's drawings and their resulting scores.

Training Procedure

After screening, the experimental group were trained on the three screening items, the mug, the clock and the brush. The objects were presented one at a time in the same

manner and with the same instructions. If any errors occurred, instructions became increasingly specific until mastery was achieved.

Training sequence--The instructional training sequence was as follows.

> "Draw the _____ again. Draw only what you see from where you sit."
>
> "Can you see the (hidden feature)?" Child's answer. "Draw the _____ again. Draw only what you can see from where you sit."
>
> "Can you see the (hidden feature)?" Child's answer. "Can you see the (visible feature)?" Child's answer. "Draw the _____ again. Draw it with the (visible feature) you can see. Don't draw the (hidden feature) that you can't see."

The above set of instructions was repeated again if a mistake was still made until the child reached mastery. As soon as a correct drawing was produced the training sequence was stopped and E went on to the next object. Training was completed when all three objects were drawn accurately.

Criterion objects--There were eight criterion objects, all easily identified by the children and familiar to them. The first three objects, a mug, a clock and a brush were used during screening and in training. The following five objects were used in posttesting: a purse, iron, cup, flashlight and pan. Each object had at least one distinctive and defining feature and one distinctive and

nondefining feature as described in Table 3. See Appendix B for further description of the objects.

Table 3. Criterion Objects

Object	Defining Feature	Nondefining Feature
Pretest and Training Objects		
Mug	Handle	Flower design
Clock	Hands and numbers	Turnkeys
Brush	Bristles	Flat back and trademark
Posttest Objects		
Purse	Handle	Oval design
Iron	Handle, cord, plug	Flat surface and trademark
Cup	Handle	Geometric design
Flashlight	Switch	Circle design
Pan	Handle	Flower design

Posttesting

Procedure--The posttest objects were presented in the same manner to both the experimental and control children. However, after the training sequence was completed E invited each experimental child to stand up with her and stretch and wiggle his fingers for a short break. The five posttest items were randomly presented one at a time and the children were asked to draw them in the same manner as in

the screening test. When the drawings were completed the children were thanked and returned to their classrooms.

Posttest scoring--Scoring was the same as for screening test drawings. No points were given for totally incorrect drawings. One point was given for each correct aspect of the child's drawing.

Reference to object--A note was made for each subject as to whether he visually referred back to the object at least twice while drawing. This was scored in a yes and no fashion and was easily observed since the head had to be raised and the eyes focused upon the object. Information was sought about this occurrence due to its importance in perceiving distinctive features.

Data Analysis

To test the hypothesis of effectiveness of training a t test was computed on posttest scores of experimental and control groups. Posttest scores by age and sex were also compared using t tests. Screening test scores were correlated with age to see if any systematic relationship existed. A number of other corollary questions were answered by tabulating the occurrence of various behaviors.

Restatement of Hypothesis

The main research hypothesis was that children who were trained to draw veridically a series of concrete objects do so more correctly than do children not trained to

do so, when both groups are tested on a further series of previously unseen objects. Two ancillary questions were concerned with differences in task response due to age and sex.

CHAPTER 3

RESULTS

Main Hypothesis

The main hypothesis was that with verbal discrimination training children's drawing reference could be changed from mental image to visual object image so that more accurate drawings would be produced. A significant difference ($t = 6.25$, $p \leq .05$) was found between posttest scores of the experimental and control groups thus indicating effectiveness of training. Table 4 summarizes the results of this test.

Table 4. Posttest Main Hypothesis Results

Group	Mean	SD	t
Control	3.916	2.78	6.25*
Experimental	8.04	1.74	

* $p \leq .05$ (df = 47)

Subordinate Hypotheses

Difference by sex on posttest and screening test scores

--The subordinate hypothesis dealing with sex differences was that males and females differ in task response as

shown by posttest and screening test scores. The results indicate no difference between male and females in their responses to training (experimental group) or their performances without training (control group). Tables 5 and 6 summarize thses results. Table 7 summarizes results showing there were no initial differences in males and females on screening test scores.

Table 5. Sex Differences on Posttest Scores By Control and Experimental Groups

Group	Sex	N	Mean	SD	t
Control	Males	13	3.25	2.66	-1.187*
	Females	11	4.58	2.84	
Experimental	Males	13	7.64	1.90	-1.649**
	Females	12	8.72	1.19	

* $p \leq .05$ (df = 22)
** $p \leq .05$ (df = 23)

Table 6. Sex Differences By Posttest Scores

Sex	N	Mean	t
Males	26	5.651	-.898*
Females	23	6.565	

* $p \leq .05$ (df = 47)

Table 7. Sex Differences of All Students on Screening Test Scores

Sex	N	Mean	t
Male	42	2.785	1.178*
Female	43	3.279	

* $p \leq .05$ (df = 85)

Difference by age on posttest scores--The subordinate hypothesis dealing with age was concerned with differences in task response by age as shown by posttest scores. A difference was found between the experimental groups posttest scores when the groups were divided into the global age categories of 3-4 year olds and 5-6 year olds, the older group outscoring the younger. Results are summarized in Table 8.

Table 8. Difference By Age on Posttest Scores

Group	N	Mean	t
3-4 years	35	5.42	t=-2.71*
5-6 years	14	7.50	

* $p \leq .05$ (df = 47)

Age-score correlation--A product moment correlation of .14 ($p = .05$ $df = 81$) was found between age in months and score on the screening test for all children. The hypothesis that performance increases with age was not supported. However the narrow range of scores must be considered as influencing this finding. A chi-square statistic of 4.523 ($p \leq .05$ $df = 1$) as shown in Table 9 shows that proportionally more 5-6 than 3-4 year olds were deleted from the study indicating that there was some response difference between the two groups.

Table 9. Contingency Table for Age and Subject Groups

	3-4 year olds	5-6 year olds	total
Experimental Subjects	35	14	49
Deleted Subjects	17	18	35
Total	52	32	84

Ancillary Questions

Motor ability--All children exhibited sufficient motor ability to perform the drawing tasks demanded of them.

Recognition and labeling ability--All the children were easily able to identify and give a verbal label to each stimulus object.

Visual reference to the object--Almost all the children visually referred back to the object they were drawing. There were no differences found between screened or experimental children, age groups or sex groups in this regard. Table 10 summarizes these results.

Table 10. Visual Reference Back to Objects

Group	Sex	Referred Back to Objects Yes	No	Total%
Deleted	Males (N = 15)	15	0	100%
	Females (N = 20)	20	0	
Experimental	Males (N = 26)	25	1	97.9%
	Females (N = 23)	23	0	

Training trials--The mean number of training trials to mastery for the experimental group was 3.28 (S = 0.80). The mean of the training trials indicates the number of drawings which a child produced before drawing all three training objects correctly.

CHAPTER 4

DISCUSSION AND IMPLICATIONS OF RESULTS

The results of this study are reviewed in this chapter in relationship to the concerns voiced in the related literature: the effects of and relationships among motor ability, perceptual ability, age, sex, cognitive functioning, verbal cueing and discrimination training are discussed as influences upon children's graphic development.

Prerequisite Abilities

As expected, all the children in this study exhibited sufficient motor ability to easily comply with the task demanded of them. Motor ability is again verified as a necessary prerequisite to any drawing task.

Perceptual ability is also a necessary prerequisite to any drawing task. All children exhibited enough skill in this area to perform the required tasks. They were able to recognize and verbally identify each object presented. All but one child visually referred back to the objects while drawing. This referral has been stated as important in analyzing distinctive features of the stimuli, a necessary prerequisite for accurate graphic reproductions.

Despite this perceptual behavior signifying the children's apparent perceptual ability, 59% of the initial group of children sampled failed to reach mastery when drawing the screening test items. The lag between perceiving and performing described by Maccoby (1968) and others was therefore verified in this study.

Hypothesis Tests

Cognitive functioning has been hypothesized as a reason for children's lag between perceiving and performing. Children are said to focus on mental images and not their perceived images when asked to graphically copy a concrete object. This phenomenon has been found to be age-related in that older children draw more accurately than younger children. In this study the experimental procedure was set to encourage children to activate pre-existing mental schemas of the stimulus objects by having children view the objects and name them as they were presented. The experimental group had apparently fixated on this mental image as they incorrectly produced at least two of the three screening drawings. This result does not explain the high percentage of children of the same ages (41%) who did not make any initial errors and were therefore deleted from the study. Nor does it explain the fact that all children except one visually referred back to the objects while drawing.

There were age differences between the group deleted by the screening test and those not reaching criterion and thus retained for the experiment: a greater proportion of the older children were deleted than younger children. However, this relationship was not supported by a correlation between age in months and screening test scores. After experimental manipulation, older children outscored younger children on posttest scores, also indicating a difference in task response by age. However, there was no difference by sex indicated on measures of posttest or screening test scores.

To summarize, children between the ages three and one half and six and one half regardless of sex are physically and perceptually able to draw simple objects veridically. However, 59% of the subjects did not do so when presented with a three object screening task. It may be concluded that these children activated mental images and that they focused upon these images and not the perceived images as they drew.

Discrimination Training

The main reasearch hypothesis then followed that these children could be trained to draw veridically through a verbally mediated discrimination paradigm. The study's results supported this hypothesis. The relative ease with which children responded to training was shown by the

relatively low mean number of training trials to mastery (Mean = 3.23 S = 0.80). Since there were only three training objects, this figure indicates that most children responed immediately to the demands of the experimental situation and subsequently modified their drawing behavior. They no longer focused upon the cued mental image but referred while drawing to the actively perceived object.

Verbal Cueing

Discrimination training and verbal labeling or cueing suggest themselves as compelling reasons for altered response after training. When Olson (1968) demanded very accurate discriminations on variations of diagonal lines compared to a standard the children responded with very high scores when perception was measured by recognition of the diagonals. However, none of his subjects subsequently constructed correct diagonal lines. In a follow-up study (Olson 1968) the children in voiced verbal training groups who were required both to code for themselves a rule and were prompted by the experimenter, (E asked, "Why isn't that a crisscross? Where does a crisscross start?" [p. 178]) were highly successful in constructing diagonals. The function of the verbal codes was to define what the E wanted the child to do, since he already had proven the motor and perceptual capacity to perform. Verbal discrimination

training in the present experiment may have served the same function--to place constraints on the way in which children respond.

As Arnheim (1968) has suggested, the purpose of the task must be sufficiently defined for the subject before he can perform to the experimenter's expectations, "Discrimination is as neat as the task demands but no neater" (p. 205).

The results of the present experiment indicate that the degree of accuracy initially required may be in fact only in the mind of the experimenter. That is, the child thinks the experimenter is asking him to draw "a cup" and not "the cup in front of him." Freeman and Janikoun's (1972) instructions to the child in his study dealing with familiar objects were, "I should like you to draw exactly what you can see from where you are sitting" (p. 1118). The answer to that question is "I can see a cup. He wants me to draw a cup." In the present study the questions ran, "What is this? (Child's answer) Draw the _____ as you see it from where you sit." The high percentage (41%) of students deleted from the study on screening due to reaching criterion may have understood the task requirements immediately, had accurate perceptions, and passed the requisite motor ability and therefore responded correctly. The group of children who did not "catch on" and went into training may have

quickly realized where they had erred when the more specific task demand of "Draw the _____ again. Draw only what you can see from where you sit." was given to them. The control children who did not understand the requirements initially may have continued to misinterpret the instructions in post-testing. They, in effect, continued to answer the question "She wants to draw a _____."

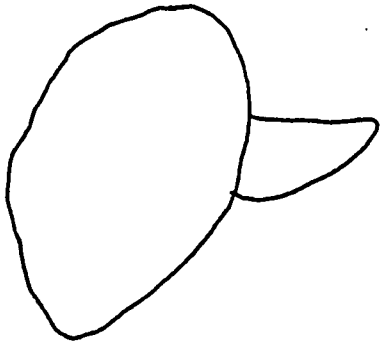
Conclusions

The importance of these results lies in the number of situations in which accurate copying is required of young children. The relationship between perceptual cues, conceptual ability and labeling parts of a stimulus may be joined by the problem of precise instructions which allow children to respond correctly.

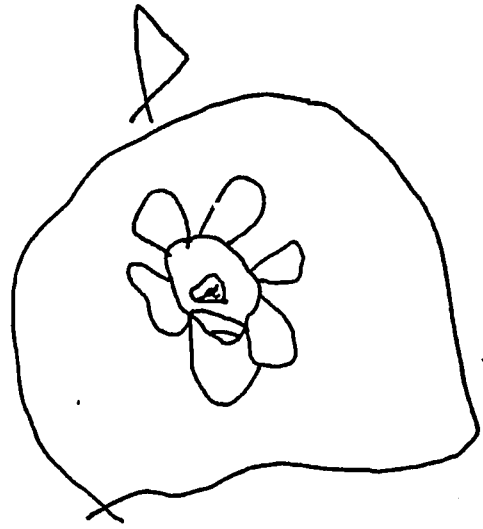
Many times adults expect children to accomplish tasks or respond to problems from our own restructed viewpoints and then correct or praise them accordingly. The implications of research findings strongly suggest that for dealing with children the level of specificity desired must be considered carefully lest we place children in situations in which failure is the probable outcome.

APPENDIX A

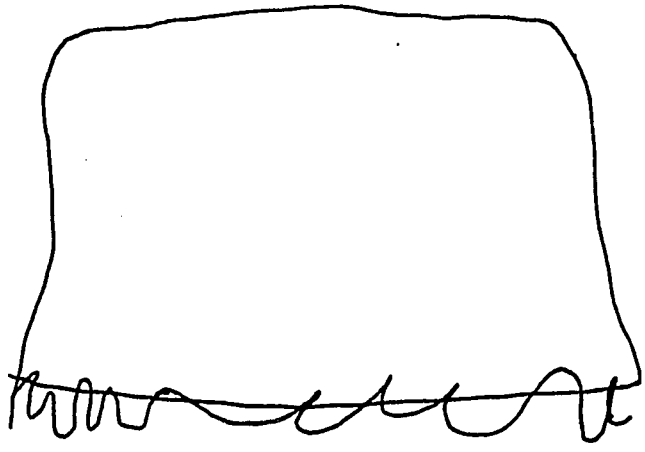
CHILDREN'S DRAWINGS AND THEIR RESULTING SCORES



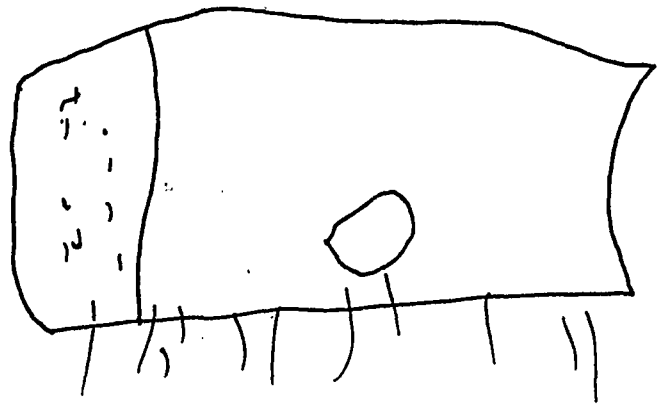
Female age 4 years 10 months
Score = 0 Cup



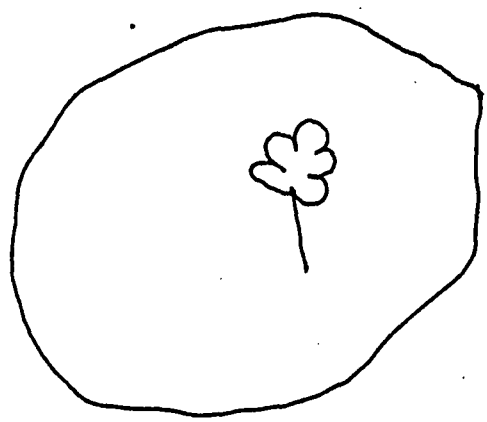
Male age 5 years 1 month
Score = 1 Cup



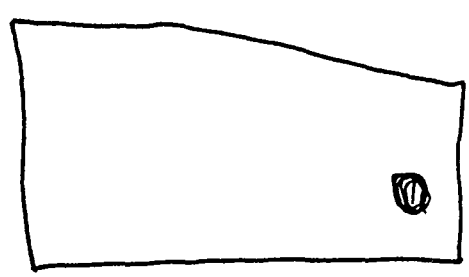
Male age 4 years 8 months
Score = 0 Brush



Female age 4 years 4 months
Score = 1 Brush



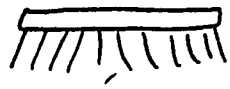
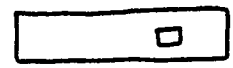
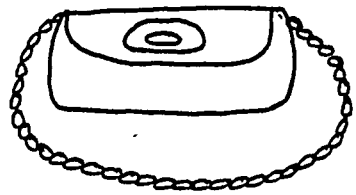
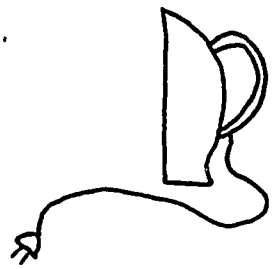
Female age 5 years 1 month
Score = 2 Cup

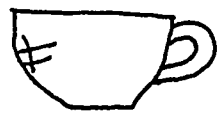
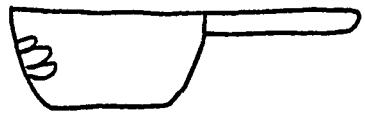


Female age 4 years 7 months
Score = 2 Brush

APPENDIX B

CRITERION OBJECTS

Pretest and Training	Defining Feature	Nondefining Feature
Mug		
Clock		
Brush		
Posttest		
Purse		
iron		

Posttest	Defining Feature	Nondefining Feature
Cup		
Flashlight		
Pan		

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