A STUDY OF RIGIDITY AND FLEXIBILITY IN PRESCHOOL CHILDREN'S BEHAVIOR IN A PROBLEM SOLVING SITUATION

By

LINDA SUE GEURKINK

Bachelor of Science

Oklahoma College for Women

Chickasha, Oklahoma

1963

Submitted to the faculty of the Graduate School of
the Oklahoma State University
in partial fulfillment of the requirements
for the degree of
MASTER OF SCIENCE
August, 1965

A STUDY OF RIGIDITY AND FLEXIBILITY IN PRESCHOOL CHILDREN'S BEHAVIOR IN A PROBLEM SOLVING SITUATION

Thesis Approved:

Elizabeth K. Shackelford
Thesis Adviser

Stanley E. Fowler

Dean of the Graduate School

ACKNOWLEDGEMENTS

The writer wishes to express her most sincere appreciation to her adviser, Dr. Elizabeth K. Starkweather, whose insight, guidance, and untiring efforts made this study possible.

The writer wishes to thank Dr. Stanley E. Fowler for his critical reading of the manuscript; Mrs. Bobby Halbrook, Mrs. Wanda Flora, Mrs. Carol Foster, Mrs. Sally Douglas, Mrs. Opal Collins, and Mrs. Virginia Powers for their cooperation; and the children who played the games with enthusiasm and made this study enjoyable and enlightening for the writer.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Purpose

The purpose of this research is to study rigidity and flexibility in preschool children's behavior in a problem solving situation. The effects of two methods of training on children's ability to make reversal shifts will be examined. For this, children's responses to three dimensions in a visual discrimination task will be studied. The training methods employed will be (1) the random presentation of three dimensions in a series of problem solving tasks and (2) the consecutive presentation of each dimension in a series of problem solving tasks.

Definition of Reversal Shift

A reversal shift is a change in the response to a problem solving situation when a previously learned correct response is no longer correct. For example, when black has been the correct choice between paired black and white stimuli, a reversal shift is required when white becomes the correct choice. In the present research, rigidity or flexibility will be evidenced by the difficulty or ease with which the children make reversal shifts.

Problem

In an attempt to understand the preschool child's approach to learning, considerable child development research has been focused on the exploration of patterns of problem solving. Problem solving behavior begins in early childhood, and the approaches to problem solving which are established early in life may either facilitate or inhibit later attempts to learn and to adapt in a constantly changing world. This general belief points to the need for research which will increase our knowledge of children's early learning behavior. Such knowledge is need if we are to facilitate the development of cognitively guided behavior in childhood and later years.

The present research is seen as a contribution to this broad problem in that principles believed to be involved in adaptation to a constantly changing world will be explored. Adaptation to change demands flexibility as opposed to rigidity and demands reflective behavior as opposed to impulsive behavior. The preschool child's tendency to be rigid or flexible and methods of training which might produce impulsive or reflective behavior will be examined in the present research. Impulsive behavior is necessarily rigid, whereas reflective behavior provides for flexibility.

Procedure

The following steps were involved in studying rigidity and flexibility in preschool children's behavior in a problem solving task:

1. Review of literature to gain an understanding of theory related to discrimination learning and to gain an understanding of methods used to study learning behavior.

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

3. Development of the instrument which included a demonstration task, a pretest matching task, a training task, and a reversal shift task.

4. Administration of the instrument to 32 children, 16 in a control group and 16 in an experimental group.

5. Analysis of data.

6. Interpretation of results and recommendations for future use of the instrument.

CHAPTER II

REVIEW OF LITERATURE

Due to the complexity of the problem solving process, it cannot be studied in its entirety. The literature review for this study will include: a discussion of the theory of discrimination learning and the transfer of discrimination learning; some findings from studies related to learning behavior in preschool children; a review of studies which have employed reversal shifts in an attempt to study the problem solving process; and implications for the present research.

Discrimination Learning

Discrimination learning, which may occur in a number of way, requires the subject to make a differentiated response between stimuli in either successive or simultaneous presentations. This differentiation takes place when a choice is given and a subject makes a response to one stimulus and not to others. Discrimination is developed through a reward or reinforcement for correct responses or through punishment or nonreinforcement for incorrect responses.

Spiker (1960) classifies discrimination learning in several ways, e.g., differential conditioning, successive or patterned discrimination learning, and simultaneous discrimination learning.

Differential conditioning involves the successive presentation of at least two different stimuli. The response to one stimulus is rewarded, while the response to the other stimulus is not rewarded.

Differential conditioning can be developed by one of two methods. In the successive-phase method the subject is consistently rewarded for responding to a positive stimulus, a negative stimulus is introduced without a reward, and both stimuli are then presented in a random order until the subject's response is consistently differentiated. For example, a child is presented with a cube and is rewarded when he reaches for it. After he has developed a consistent response of reaching for the cube, a ball is then introduced. When he reaches for the ball, no reward is given. Then the ball and the cube are presented in a random order until the response to reach for the cube is consistent, and the response to reach for the ball is extinguished.

In the mixed-phase method both stimuli are presented alternately from the beginning. For example, a child is presented with a cube and his response of reaching for it is rewarded. He is then presented with a ball and his response is not rewarded.

Successive or patterned discrimination learning requires the subject to respond in one manner to a given stimulus and in a different manner to other stimuli presented at other times. For example, if a child is required to select the left one of two black objects and the right one of two white objects, on different trials, the problem is called a successive or patterned discrimination problem (Spiker, 1960).

Simultaneous discrimination learning requires the subject to respond to one of two or more objects presented simultaneously. Schoeffer and Gerjuoy (1955) employed this method of studying discrimination learning in a task in which rewards were hidden under wooden cubes. The subject was required to pick up a cube of a certain hue in order to receive a reward.

According to Spiker (1960) simultaneous problems can be adapted to children of different ages. Problems can be made more difficult by increasing the similarity of the stimuli, by increasing the number of stimuli, and by increasing the number of simultaneous discriminations the subject is to make concurrently. For example, if a subject is required to choose the black stimulus of a pair of black and white objects, and to choose the square stimulus of a pair of square and round objects, he is concurrently learning a brightness and form discrimination problem.

Instructions given to the subject about a discrimination problem have been found to affect the difficulty of the task. Weiss (1954) demonstrated that preschool children who were told the principle involved in a discrimination problem, i.e., were told which stimulus box would always contain the reward, learned significantly faster than children who had to learn the principle for themselves. He also suggested that calling the child's attention to the relevant dimensions of the stimulus objects facilitated the subject's learning. For example, in a brightness discrimination problem the experimenter would say, "Here is a black one and a white one," to point out the relevant dimension to the child.

Transfer of Discrimination Learning

Transfer of discrimination learning has been studied in the context of the formation of learning sets. Harlow (1949) found that preschool children's ability to learn simultaneous discrimination problems improved as a function of the number of previous discrimination problems they had learned. This was true even when the stimuli in the discrimination

problems were unrelated to the previously learned problems. Therefore, he concludes that the ability to learn is transferred from one experience in learning to another.

Transposition experiments provide another example of transfer of learning. Research has shown that preschool children can transpose on size discrimination problems. For example, if a child learns to select the larger of two objects, the next time two objects of different sizes appear, he selects the larger (Kuenne, 1946; Shepard, 1957).

Transfer of discrimination learning has been facilitated by the verbal labeling of the stimuli. Learning the names of the stimuli in simulatneous and successive discrimination problems has been shown to facilitate learning in subsequent discrimination problems involving the same stimuli (Cantor, 1955; Norcross and Spiker, 1957).

Studies Related to Learning Behavior

Problem solving, viewed as the interaction of learning, perception, and motivation, can be studied in a variety of experimental situations. According to Kendler and Kendler (1962), some researchers have studied problem solving in 'true life' situations, while others have invented experimental situations which capture the flavor of problems met in everyday life. Still others have attempted to isolate basic processes of problem solving and study them with a more analytical approach.

Experience in learning has been found to facilitate subsequent learning. Shepard (1957) studied the formation of learning sets with children between the ages of four and six years. She used a conditional space discrimination task and noted a marked improvement in performance from the first to the subsequent tasks in a series.

In addition to previous learning experience influencing learning behavior, Norcross and Spiker (1957) found that verbal lables attached to the stimuli in learning tasks will produce superior performance on that task. In their study preschool children were given three types of pretraining for a simple discrimination learning situation involving a pair of highly similar but discriminable pictures. Group R attached discrete names to the pictures, Group D learned to respond verbally saying "same" or "different", and Group I learned the names for control pictures different from those used in the test. Group R performed significantly better than either Group I or Group D.

Kendler and Kendler (1956) found that preschool children are capable of inferential behavior in a problem solving situation. Their study was set up with four experimental and four control groups, each consisting of 16 children. Experimental children received three separate training experiences. The children learned to pull A to get subgoal B, to pull X to get subgoal Y, and to pull B to get major goal G. The control group received a similar set of three experiences, with the exception that the major goal G was not proceded by B. The test for inferential behavior occurred when the children were then instructed to chose between A and X to reach major goal G. Significantly more experimental children than control children chose A. These results were interpreted as demonstrating inferential behavior in preschool children.

Learning in a weak conflict situation prompts impulsive and rigid behavior while learning in a strong conflict situation prompts reflective behavior. Worell and Worell (1964) studied the role of previous weak, strong, and varied conflict training on performance in subsequent strong and weak conflict situations. Their findings make it clear that

performance in strong and weak conflict situations is markedly affected by the conflict severity in previous problem solving situations. Individuals who had experienced previous weak conflict, resolved subsequent weak and strong conflict situations more quickly than those who had a background of strong conflict. On the other hand, previous strong conflict experience impaired the speed of solving problems in similar conflict situations.

Individuals trained in weak conflict situations develop a tendency to respond quickly regardless of the strength of the present conflict situation. Worell and Worell (1964) indicated that such persons might be labeled 'impulsive' since they tend to react to all situations as though they were relatively weak conflict situations.

Studies Involving Reversal Shifts

A number of studies have used reversal and nonreversal shifts in simple concept learning tasks as one method of studying the problem solving process. A reversal shift is a change in the response to a problem solving situation when a previously learned correct response is no longer correct.

Basic to all studies employing reversal shifts is the question of what makes the subject change his response. Introspective reports fail to provide any clear-cut answers. However, Kendler and Vindberg (1954) explained the change of response in a reversal shift in terms of mediational theory. In mediational theory the mediator is a covert response or a series of responses, which intercede between the external stimulus and the overt response.

Studies have been done to indicate that a mediational theory is necessary to explain the concept learning of articulate humans, even

though a single unit S-R theory, in which the external stimulus and the overt response are directly connected, can accurately represent the behavior of lower animals (Kelleher, 1956; Buss, 1956; Harrow and Friedman, 1958; Kendler and D'Amato, 1955).

Specifically, in a reversal shift situation, the first nonreinforcement sets off a chain of correct responses which result in the subsequent selection of a response other than the one that was previously correct. Kendler (1962) gave several explanations for this change of response, e.g., logical consideration, forgetting, et cetera.

Children tend to respond in a manner consistent with a single unit S-R theory during their early development. With increasing age, the development of a mediational response begins to appear.

Kendler and Kendler (1959) found that a group of kindergarten children executed reversal and nonreversal shifts at approximately the same rate. In the same study the children were divided into fast and slow learners; slow learners performed according to the single unit S-R theory while fast learners performed according to the mediational theory.

The findings of their study led to a similar investigation with still younger preschool children. Kendler, Kendler, and Wells (1960) found that nursery school children execute a nonreversal shift more easily than a reversal shift, confirming the theory that the mediated response develops with maturity.

Implications for the Present Research

The studies of learning behavior and problem solving reported in this chapter gave implications for the present research.

1. Several factors make problem solving in discrimination tasks less difficult for preschool children: experience with learning discrimination problems, attachment of verbal labels to the stimuli, and calling the child's attention to the relevant dimensions of the stimulus objects.

2. Preschool children are capable of inferential behavior.

3. Learning in a weak conflict situation prompts impulsive and rigid behavior while learning in a strong conflict situation prompts reflective behavior.

4. The mediated response develops with maturity, and therefore, the ability to make reversal shifts increases with age.

CHAPTER III

METHOD AND PROCEDURE

This chapter will include a description of the subjects used in the study, a discussion of the pilot work in developing the instrument, a description of the instrument including directions for administration and scoring, and recommendations for analysis of the data.

Subjects

The subjects who participated in this study were 32 children, boys and girls, ranging in age from three years and eleven months to five years and four months. The group was composed of children who attended community nursery schools, kindergartens, or day care centers. Control and experimental groups of children were matched on age within three months and on scores obtained on a pretest designed to measure the child's tendency to be rigid or flexible in his generalizing behavior.

Pilot Work

Certain questions necessarily arise when an attempt is made to design a study which will indicate the influence of different training methods on children's behavior in problem solving situations.

The major questions for consideration are the following:

1. Factors other than the training method itself might affect a child's behavior in the final problem solving or test situation. The

possibility that children may tend to be rigid or flexible prior to their participation in the research suggests that in the selection of subjects this tendency towards rigidity or flexibility should be controlled. Age is another factor which should be controlled because of the possibility of marked individual differences in young children's problem solving ability.

2. Specific training methods which would encourage a rigid approach and training methods which would encourage a flexible approach are needed. Research findings indicate that training in a weak conflict situation tends to produce rigid or impulsive behavior, and that training in a strong conflict situation tends to produce flexible or reflective behavior.

3. A test is needed which would measure the influence of chosen methods of training on children's behavior in problem solving situations. Specifically, in this research such a test should be a discrimination task which would indicate the children's tendency toward impulsive or reflective behavior.

Pretest Matching Task

An instrument was needed to test the rigidity or flexibility of the children prior to their training in this research. Specifically an instrument was needed which would measure the rigidity or flexibility with which the children generalize about the concepts of color, form, size, and pattern.

Step One. A matching task was used to explore the ways in which children match objects when there is a choice of method, i.e., matching according to color, form, size, and pattern. A set of 32 styrofoam

objects differing on these dimensions was presented to ten children. The children were allowed to manipulate the objects and were encouraged to match them in as many ways as they desired.

Some children seemed rigid and showed a strong preference for matching on one particular dimension, while others seemed more flexible and used the four dimensions in their matching. This confirmed the belief that the tendency to generalize or match, in a rigid or flexible manner, is a variable which should be controlled in the present research.

A major problem with this matching task was that objective scoring was impossible.

Step Two. In view of the problems encountered with the task, an attempt was made to set up a more structured situation in which the matching responses could be objectively scored. A task which included 32 sets of eight objects was constructed. In each set, one dimension was controlled and matching could be done on the other three dimensions. This task was presented to 20 children.

This task was an improvement over the first; however, since two objects could frequently be matched on more than one dimension, scoring often depended upon a verbal response from the child.

Step Three. The final step in the development of the matching task corrected the scoring problem. The task was designed so that the child could hold one object and make his choice of a matching object from three other objects, each of which matched his object on one dimension only. With this change in design, the child's behavior clearly indicated the dimension on which he was matching.

Pilot work with the task indicated the need to clarify the meaning of "match" or "belong together" in the instructions that were given to

the child. This problem was solved by the construction of a demonstration task which showed the child all the possible ways of matching the objects.

These two instruments, the demonstration task and the matching task, are illustrated and described in Appendix A.

Training and Reversal Shift Task

Two methods were designed to train children in a problem solving situation. Both methods of training involved the child's learning the correct responses in a game which required him to choose between two alternatives based on the dimensions of brightness, form, and size. The two methods differed only in the order in which the three dimensions were presented. One method provided the children with an opportunity to learn the correct responses for the three dimensions in a random order. The assumption was that this order of presentation would facilitate reflective and flexible behavior. The other method provided the children with the opportunity to learn the correct response to one dimension before the next dimension was introduced. Here, the assumption was that this order of presentation would facilitate impulsive and rigid behavior. This instrument is illustrated and described in Appendix A.

A reversal shift task was designed to measure the influence of the two training methods on the children's approaches to a problem solving situation. This task was exactly like the training task in which the dimensions were presented in a random order. The reversal shift required that the child change the responses he had learned during the training period. The responses which he had learned as correct were now incorrect.

The training task and the reversal shift task were then administered to 15 children. The experimenter gave initial directions to the child and then made no comment during the remainder of the session. With this type of administration, the children showed some impulsive behavior and became fatigued before learning the task. A modification of the administration procedure was needed.

Several different methods of administering the task were tried. A method was needed in which the children would be given verbal support during the initial stages of the task but would not be deprived of the problem solving element of the task.

The method of administration accepted for the research consisted of calling the child's attention to the relative dimensions of each pair of objects for the first three times each dimension appeared in the task. Then the experimenter made no comment as long as the child's responses were correct. After an incorrect response on any one of the dimensions, the experimenter again verbally called the child's attention to that dimension the next time it appeared in the task. For example, if the child responded incorrectly to a pair of objects distinguished by size, the next time size was the dimension, the experimenter would say, "Here's a big one and a little one."

Research Instrument

The four tasks employed in this research instrument are illustrated and described in detail in Appendix A.

Demonstration Matching Task

The purpose of the demonstration matching task was to familiarize the children with the instrument and to show them the ways in which the objects could be matched on color, form, size, and pattern. The task consisted of 12 sets of styrofoam objects. In each set there were three objects, two of which could be matched on one or more of the dimensions. In the administration, as each set was shown to the child, the experimenter picked up one of the matching objects and asked the child to show her the one that was like it or belonged with it.

Pretest Matching Task

The purpose of the pretest matching task was to determine the extent to which each child preferred one or another of the four dimensions in matching objects. The possibility that some children might adhere rigidly to one dimension and others might shift readily from one dimension to another, suggested that this tendency could influence their performance in the research and, therefore, should be controlled in the selection of children for the experimental and control groups.

The pretest matching task consisted of 24 sets of objects. Each set included one object for the child to hold and three other objects from which he could choose one that matched his. In each set of objects, one dimension was controlled (e.g., Set 1: pattern), and the child's choice of an object indicated the dimension on which he was matching (e.g., Set 1: color, form, size).

Scoring of this pretest matching task consisted of a numerical count of responses the child made on each dimension. The child was

considered to be rigid if the score for any one dimension was more than or equal to the sum total of the scores for the other three dimensions. The child was considered to be flexible if his largest score was less than the sum total of the other three scores.

Training Task

The purpose of the training task was to teach the child to make correct responses in a game which required him to choose between two alternatives. These alternatives were based on three dimensions: brightness, form, and size.

The apparatus for the task was a green turntable one foot square, divided in half by a partition five inches high. On each side of the partition were two holes in which a reward object (a small beaded peg) could be placed. These holes, two inches square and three inches apart, were covered by lids on which the stimulus objects made of styrofoam were fastened. Thus, when the child made his choice between the two stimulus objects, he picked up one of the objects and uncovered one of the holes. If he made a "correct" choice, he found a reward; but if he made an "incorrect" choice, he found nothing.

The stimulus objects were 16 paired objects differing in brightness (A: black and white), 16 paired objects differing in form (B: square and cylinderical), and 16 paired objects differing in size (C: large and small). The black, the square, and the large in these paired objects were the positive stimuli which constituted the correct responses in this task.

The training task was administered in two ways. Children in the experimental group were presented with the three dimensions in a random

order (A-B-C, B-C-A), and they simultaneously learned the correct responses to all three dimensions. This method of presentation was assumed to instigate reflective behavior. Children in the control group were presented with one dimension (e.g., brightness) and they learned it before the next dimension was introduced. This method of presentation was assumed to instigate impulsive behavior.

For both groups, the criterion for learning was nine correct responses out of ten. For the experimental group, the random presentation of all three dimensions continued until the child responded correctly to each dimension nine times out of ten. For the control group, one dimension was presented until the child responded correctly nine times out of ten, and then the next dimension was introduced. For each method of presentation the scoring was a simple count of the number of trials required to reach the criterion for learning.

Reversal Shift Task

The purpose of the reversal shift task was to measure the influence of chosen methods of training on children's tendency toward impulsive or reflective behavior. Specifically, the reversal shift task provided a problem solving situation in which a change in a learned response was required and the children's ability to make the change was measured.

For this task the apparatus and stimulus objects were the same as those used in the training task; however, the stimuli which were "incorrect" in the training task were the "correct" stimuli in the reversal shift task. (The white, the cylinderical, and the small were the positive stimuli which constituted the correct responses in the reversal shift task.)

This reversal shift task was administered immediately after the training task. The experimenter explained, "Now we're going to play a new game." The paired stimuli were then presented in a random order, as in the method of presentation for the experimental group in the training task.

In the reversal shift task, the score for each child was a simple count of the number of incorrect responses made in a series of 30 reversal shifts.

Recommended Analysis

The data gathered in this study should be analyzed to answer the following questions:

1. Does the tendency toward rigidity or flexibility prior to the administration of the training task influence the child's behavior on the reversal shift task?

2. Do the children learn the correct responses in the training task more readily when the method of presentation is random or when it is consecutive?

3. Are the number of incorrect responses made during the reversal shift task a function of the method of training?

CHAPTER IV

RESULTS

The purpose of this research was to study rigidity and flexibility in preschool children's behavior in a problem solving situation. The instrument developed for use in this study was composed of a pretest matching task, a training task, and a reversal shift task.

The pretest matching task was developed to test the flexibility or rigidity of the children prior to their participation in this research. Specifically, this instrument measured the rigidity or flexibility with which the children generalized about the concepts of color, form, size, and pattern.

Two methods of training the children in a problem solving situation were developed. The training methods for the experimental group, one in which the stimuli were presented in a random order, was assumed to facilitate reflective and flexible behavior. The training method for the control group, one in which the stimuli were presented in a consecutive order, was assumed to facilitate impulsive and rigid behavior.

The reversal shift task was used to measure the influence of the two methods of training on the children's tendency toward impulsive or reflective behavior. The reversal shift task was exactly like the training task in which the dimensions were presented in a random order. It provided a problem solving situation which required the child to reverse the responses he had learned during the training period.

Three major analyses of the data gathered in this research were possible. (1) The rigidity or flexibility of the children prior to training in the research was measured, and an analysis was made of the possible influence of the rigidity or flexibility on the children's behavior in the reversal shift task. (2) A comparison was made of the facility with which the children learned under the two methods of training. (3) An analysis was then made of the influence of the two methods of training on the children's behavior in the reversal shift task.

Influence of Rigidity or Flexibility Prior to Training

The measurement of rigidity or flexibility of the chilren prior to their participation in the research provided a basis for matching the experimental and control groups. In each group there were nine flexible children and seven rigid children. If the rigidity or flexibility of the child was a major factor influencing this behavior on the reversal shift task, the flexible child, regardless of the training he received, would make fewer incorrect responses than the rigid child.

The Mann-Whitney U test was used to compare the number of incorrect responses made on the reversal shift task by the 18 flexible and the 14 rigid children participating in this study. There was no significant difference in the number of incorrect responses made by the two groups of children ($U = 50$; n.s.).

A comparison was also made of the number of incorrect responses made by the rigid and flexible children within the experimental group, and by the rigid and flexible children within the control group. If the rigidity or flexibility of the child was a major factor influencing his behavior on the reversal shift task, the flexible child in the

in the experimental (control) group, would make fewer incorrect responses than the rigid child in the same group.

There was no significant difference in the number of incorrect responses made by the rigid and flexible children in the experimental group ($U = 26.5$; n.s.), nor by the rigid and flexible children in the control group ($U = 25.5$; n.s.).

Number of Trials Required to Reach Criterion for Learning

A comparison was made of the facility with which the children learned under the two methods of training. A Chi Square analysis indicated that children in the experimental group, who were given a random presentation of the stimulus objects, required more trials to reach the criterion for learning than did children in the control group, who were given a consecutive presentation ($X^2 = 12.500$; $p < .001$).

A comparison was also made of the facility of learning demonstrated by the rigid and flexible children within the experimental group and by the rigid and flexible children within the control group.

A Mann-Whitney U test indicated that there was no significant difference in the number of trials to reach the criterion for learning required by the rigid and flexible children in the experimental group ($U = 28$; n.s.). For the control group a significant difference was found. The flexible children in the control group required more trials to reach the criterion for learning than did the rigid children in the control group ($U = 11$; $p < .05$).

Influence of Training Methods on Reversal Shift Scores

The primary purpose of this research was to study rigidity and flexibility in preschool children's behavior in a problem solving situation. This was operationalized as a study of the effects of two methods of training on children's ability to make reversal shifts. If the training method used with the experimental group actually did facilitate flexible behavior, and if the training method used with the control group facilitated rigid behavior, the children in the experimental group would make fewer incorrect responses on the reversal shift task than would children in the control group.

The Mann-Whitney U test indicated that the children in the experimental group, who were given a random presentation of the stimulus objects, made significantly fewer incorrect responses in the reversal shift task than did the children in the control group, who were given a consecutive presentation ($U = 73.5$; $p < .05$).

Summary

Analyses of the data gathered in this study revealed the following:

1. The rigidity or flexibility of the children prior to their participation in the research did not influence their behavior in the reversal shift task.

2. Children in the experimental group who were given a random presentation of the stimulus objects, required more trials to reach the criterion for learning than did the children in the control group, who were given a consecutive presentation.

3. The flexible children in the control group required more trials to reach the criterion for learning than did the rigid children in the control group.

4. Children in the experimental group made significantly fewer incorrect responses in the reversal shift task than did the children in the control group.

CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of this research was to study rigidity and flexibility in preschool children's behavior in a problem solving situation. The subjects were 32 children, boys and girls, ranging in age from three years and eleven months to five years and four months. The instrument developed for use in this study was composed of a pretest matching task, a training task, and a reversal shift task. The tasks were administered to an experimental and a control group who were matched on age within three months and on scores obtained on the pretest matching task.

The pretest matching task was employed to test the rigidity or flexibility of the children prior to training in the research. This instrument measured the rigidity or flexibility with which the children generalized about the concepts of color, form, size, and pattern. Scoring on the pretest consisted of a numerical count of responses the child made on each dimension.

The training task was used to teach the children to make correct responses in a game which required them to choose between two alternatives. These alternatives were based on three dimensions: brightness, form, and size. Two methods of training were developed. The training method for the experimental group, one in which the stimuli were presented in a random order, was assumed to facilitate reflective and flexible behavior.

The training method for the control group, one in which the stimuli were presented in a consecutive order, was assumed to facilitate impulsive and rigid behavior. For both groups the criterion for learning was nine correct responses out of ten responses on each dimension. The scoring consisted of a simple count of the number of trials required to reach the criterion for learning.

The reversal shift task was used to measure the influence of the two methods of training on children's tendency toward impulsive or reflective behavior. The reversal shift task provided a problem solving situation in which a change in a learned response was required and the children's ability to make the change was measured by a simple count of the number of incorrect responses made in a series of 30 reversal shifts.

The rigidity or flexibility of the children prior to training in this research did not influence their behavior in the reversal shift task. Children in the experimental group who were given a random presentation of the stimulus objects, required more trials to reach the criterion for learning than did the children in the control group, who were given a consecutive presentation. The flexible children in the control group required more trials to reach the criterion for learning than did the rigid children in the control group. Children in the experimental group made significantly fewer incorrect responses in the reversal shift task than did the children in the control group.

Implications for Future Research

In view of the findings of this research several questions are raised which suggest that the pretest matching task should be refined and the research design should be modified.

A more accurate way of measuring the children's rigidity or flexibility prior to training should be developed. The pretest matching task employed in the present research gave the child an opportunity to choose one of three objects to match an object which he was holding. Each of the three matched his on a different dimension; and his choice indicated the dimension on which he was matching. No allowance was made in this task for the child who made his choices at random with no understanding of the dimensions involved. A revision of this task should include four objects from which the child could choose. Three of these would be the same as those used in the present task, and the fourth would be an object which in no way matched the object the child was holding. This revision would make it possible to identify the child who made his choices at random with no understanding of the dimensions involved.

The findings of the present study indicate that the training given to the experimental group did instigate reflective behavior in the reversal shift task, in that the children in the experimental group reversed their responses with fewer errors than did the children in the control group. This finding could be questioned by the contention that during the training period, the experimental group became familiar with the random method of presenting the stimuli, which was the method used in the reversal shift task, whereas the control group first encountered the random method of presentation in the reversal shift task. To eliminate this problem and to answer the question as to the validity of the present findings, the study should be repeated with the same design for the training task, but with the consecutive method of presentation being used in the reversal shift task. In such a design

the control group, rather than the experimental group, would be familiar with the method of presentation. If the experimental group still made fewer errors in the reversal shift task, the findings of the present research would be supported.

Another finding of the present study was that children in the experimental group, who were given a random presentation of the stimulus objects, required more trials to reach the criterion for learning than did children in the control group. This raises the question as to whether the training method or the increased practice received by the children in the experimental group, was responsible for the facility with which they solved the problem posed by the reversal shift task. This question can be answered by repeating the study and giving the children in the control group the same number of trials during the training task as are required by the children in the experimental group.

When the above questions have been answered, the refined instrument can then be used in studies of concept formation and in studies of the influence of early experiences (e.g., different types of nursery school training) on young children's ability to adapt, to generalize, and to solve problems.

SELECTED BIBLIOGRAPHY

Buss, A. H. "Reversal and Nonreversal Shifts in Concept Formation with Partial Reinforcement Eliminated," Journal of Experimental Psychology, LII (1956), 162-166.

Cantor, G. N. "Effects of Three Types of Pretraining on Discrimination Learning in Preschool Children," Journal of Experimental Psychology, XLIX (1955), 339-342.

Harlow, H. F. "The Formation of Learning Sets," Psychological Review, LVI (1949), 51-65.

Harrow, M. and G. B. Friedman. "Comparing Reversal and Nonreversal Shifts in Concept Formation with Partial Reinforcement Controlled," Journal of Experimental Psychology, LV (1958), 592-597.

Kelleher, R. T. "Discrimination Learning as a Function of Reversal and Nonreversal Shifts," Journal of Experimental Psychology, LI (1956), 370-384.

Kendler, H. H. and M. F. D'Amato. "A Comparison of Reversal Shifts and Nonreversal Shifts in Human Concept Formation Behavior," Journal of Experimental Psychology, XLIX (1955), 165-174.

Kendler H. H. and T. S. Kendler. "Inferential Behavior in Preschool Children," Journal of Experimental Psychology, LI (1956), 311-314.

_____. "Reversal and Nonreversal Shifts in Kindergarten Children," Journal of Experimental Psychology, LVIII (1959), 56-60.

_____. "Vertical and Horizontal Processes in Problem Solving," Psychological Review, LXIX (1962), 1-16.

Kendler, H. H. and T. S. Kendler and D. Wells. "Reversal and Nonreversal Shifts in Nursery School Children," Journal of Comparative and Physiological Psychology, LII (1960),83-88.

Kendler, H. H. and R. Vineberg. "The Acquisition of Compound Concepts as a Function of Previous Training," Journal of Experimental Psychology, XLVIII (1954), 252-258.

Keunne, M. R. "Experimental Investigation of the Relationship of Language to Transposition Behavior of Young Children," Journal of Experimental Psychology, XXXVI (1946), 471-490.

Norcross, K. J. and C. Spiker. "The Effects of Type of Stimulus Pretraining on Discrimination Performance in Preschool Children," Child Development, XXVIII (1957), 79-84.

Schaeffer, M. S. and I. R. Gerjuoy. "The Effects of Stimulus Naming on the Discrimination Learning of Kindergarten Children," Child Development, XXVI (1955), 231-240.

Shepard, W. O. "Learning Sets in Preschool Children," Journal of Comparative and Physiological Psychology, L (1957) 15-17.

Spiker, C. "Research Methods in Children's Learning," in Paul H. Mussen, (editor) Handbook of Research Methods in Child Development. New York: John Wiley and Sons, Inc., 1960, pp. 374-402.

Weiss, G. "Discrimination Learning in Preschool Children Under Three Levels of Instruction," (unpub. Master's Thesis, State University of Iowa, 1954).

Worell, L. and J. Worell. "Generalization of Conflict Tolerance," Psychological Reports, XIV (1964), 203-215.

APPENDIX A

DESCRIPTION OF THE RESEARCH INSTRUMENT

Demonstration Matching Task

The purpose of the demonstration is to familiarize the children with the instrument and to show them the ways in which the objects can be matched. For this, three styrofoam objects, two of which can be matched, are shown to the child. The experimenter picks up one of the matching objects and asks the child to show her the one that is like it or belongs with it.

The ways in which the objects can be matched, i.e., the specific dimensions used in the task, are as follows:

Color : Red, Blue, Yellow.
Form : Spheres, Cubes, Triangles.
Size : Small (1"), Medium (1 1/2"), Large (2").
Pattern : Plain, Striped, Dotted.

Opportunity for three different types of matching are presented in the demonstration.

Sets 1-4 : All three objects are essentially the same, but two can be matched on all four dimensions. (e.g., Set 1: color, form, size, and pattern)

Sets 5-8 : All three objects are essentially differnet, but two can be matched on two dimensions. (e.g., Set 5: color and shape)

Sets 9-12 : All three objects are essentially different, but two can be matched on one dimension. (e.g., Set 9: color)

Description of Demonstration Sets

Each object is described in terms of the four dimensions: color, form, size, and pattern. The dimensions on which two objects in each set, A and A', can be matched are indicated by asterisks.

	Object A	Object A'	Object B
Set 1.	*Sphere	Sphere	Sphere
	*Medium	Medium	Medium
	*Plain	Plain	Plain
	*Blue	Blue	Red
Set 2.	*Cube	Cube	Cube
	*Dotted	Dotted	Dotted
	*Red	Red	Red
	*Small	Small	Medium
Set 3.	*Yellow	Yellow	Yellow
	*Medium	Medium	Medium
	*Plain	Plain	Plain
	*Cube	Cube	Triangle
Set 4.	*Sphere	Sphere	Sphere
	*Medium	Medium	Medium
	*Blue	Blue	Blue
	*Dotted	Dotted	Striped
Set 5.	Small	Large	Medium
	Plain	Dotted	Striped
	*Blue	Blue	Yellow
	*Sphere	Sphere	Triangle
Set 6.	Red	Yellow	Blue
	Plain	Dotted	Striped
	*Triangle	Triangle	Cube
	*Small	Small	Large
Set 7.	Red	Yellow	Blue
	Sphere	Cube	Triangle
	*Large	Large	Medium
	*Plain	Plain	Dotted
Set 8.	Sphere	Cube	Triangle
	Large	Medium	Small
	*Red	Red	Yellow
	*Dotted	Dotted	Plain

	Object A	Object A'	Object B
Set 9.	Sphere	Triangle	Cube
	Large	Medium	Small
	Dotted	Plain	Striped
	*Blue	Blue	Yellow
Set 10.	Red	Yellow	Blue
	Large	Medium	Small
	Striped	Plain	Dotted
	*Sphere	Sphere	Triangle
Set 11.	Red	Blue	Yellow
	Cube	Triangle	Sphere
	Striped	Plain	Dotted
	*Large	Large	Small
Set 12.	Red	Yellow	Blue
	Triangle	Sphere	Cube
	Large	Medium	Small
	*Dotted	Dotted	Plain

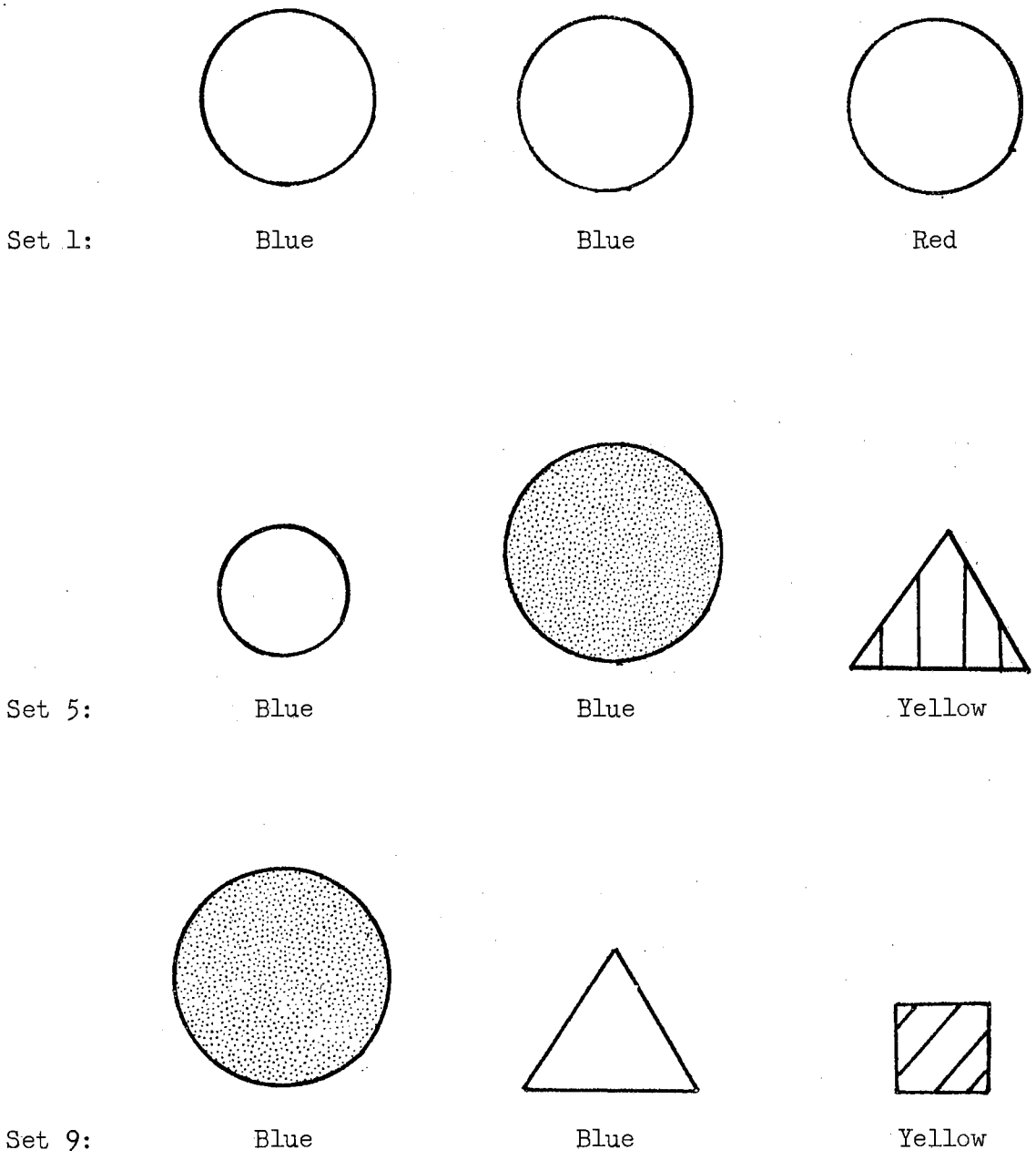


Figure 1. Illustrations of Demonstration Matching Objects

Pretest Matching Task

The purpose of the pretest matching task is to determine the extent to which each child prefers one or another of the four dimensions in matching objects. Each set includes one object for the child to hold and three other objects from which he choses one that matches his. In each set of objects, one dimension is controlled (e.g., Set 1: pattern), and the child's choice of an object indicates the dimension on which he is matching (e.g., Set 1: color, form, or size).

Description of Pretest Sets

Each object is described in terms of the four dimensions: color, form, size, and pattern. The dimensions on which the child's object can be matched with each of the other objects is indicated by an asterisk. In each set one dimension is controlled, i.e., is the same for all objects.

	Child's Object	Matching Objects		
		A	B	C
Set 1.	Blue	*Blue	Pink	Green
	Cube	Triangle	*Cube	Sphere
	Medium	Small	Large	*Medium
	Striped	Striped	Striped	Striped
Set 2.	Green	*Green	Blue	Pink
	Sphere	Cube	*Sphere	Triangle
	Large	Medium	Small	*Large
	Dotted	Dotted	Dotted	Dotted
Set 3.	Pink	*Pink	Green	Blue
	Triangle	Sphere	*Triangle	Cube
	Small	Large	Medium	*Small
	Plain	Plain	Plain	Plain
Set 4.	Red	Red	Red	Red
	Sphere	*Sphere	Cube	Triangle
	Large	Small	*Large	Medium
	Plain	Dotted	Striped	*Plain

	Child's Object	Matching Objects A	B	C
Set 5.	Black Cube Medium Dotted	Black *Cube Large Striped	Black Triangle *Medium Plain	Black Sphere Small *Dotted
Set 6.	Blue Green Triangle Small Striped	Blue Green *Triangle Medium Plain	Blue Green Sphere *Small Dotted	Blue Green Cube Large *Striped
Set 7.	Light Blue Cube Large Dotted	Grey Cube *Large Plain	Light Green Cube Small *Dotted	*Light Blue Cube Medium Striped
Set 8.	Light Green Triangle Medium Plain	Light Blue Triangle *Medium Striped	Grey Triangle Large *Plain	*Light Green Triangle Small Dotted
Set 9.	Grey Sphere Small Striped	Light Green Sphere *Small Dotted	Light Blue Sphere Medium *Striped	*Grey Sphere Large Plain
Set 10.	Yellow Green Sphere Small Dotted	Rose Cube Small *Dotted	*Yellow Green Triangle Small Plain	Yellow *Sphere Small Striped
Set 11.	Rose Triangle Large Plain	Dark Green Sphere Large *Plain	*Rose Cube Large Striped	Yellow Green *Triangle Large Dotted
Set 12.	Yellow Cube Medium Striped	Yellow Green Triangle Medium *Striped	*Yellow Sphere Medium Dotted	Rose *Cube Medium Plain
Set 13.	Green Sphere Small Striped	*Green Cube Large Striped	Pink *Sphere Medium Striped	Blue Triangle *Small Striped
Set 14.	Pink Triangle Medium Dotted	*Pink Sphere Small Dotted	Blue *Triangle Large Dotted	Green Cube *Medium Dotted

	Child's Object	Matching Objects A	B	C
Set 15.	Blue	*Blue	Green	Pink
	Cube	Triangle	*Cube	Sphere
	Large	Medium	Small	*Large
	Plain	Plain	Plain	Plain
Set 16.	Red	Red	Red	Red
	Cube	*Cube	Triangle	Sphere
	Small	Medium	*Small	Large
	Plain	Striped	Dotted	*Plain
Set 17.	Black	Black	Black	Black
	Triangle	*Triangle	Sphere	Cube
	Large	Small	*Large	Medium
	Dotted	Plain	Striped	*Dotted
Set 18.	Blue Green	Blue Green	Blue Green	Blue Green
	Sphere	*Sphere	Cube	Triangle
	Medium	Large	*Medium	Small
	Striped	Dotted	Plain	*Striped
Set 19.	Light Blue	Grey	Light Green	*Light Blue
	Cube	Cube	Cube	Cube
	Medium	*Medium	Small	Large
	Plain	Striped	*Plain	Dotted
Set 20.	Light Green	Light Blue	Grey	*Light Green
	Triangle	Triangle	Triangle	Triangle
	Small	*Small	Large	Medium
	Dotted	Plain	*Dotted	Striped
Set 21.	Grey	Light Green	Light Blue	*Grey
	Sphere	Sphere	Sphere	Sphere
	Large	*Large	Medium	Small
	Striped	Dotted	*Striped	Plain
Set 22.	Yellow Green	Rose	*Yellow Green	Yellow
	Triangle	Cube	Sphere	*Triangle
	Small	Small	Small	Small
	Plain	*Plain	Dotted	Striped
Set 23.	Rose	Yellow	*Rose	Yellow Green
	Cube	Sphere	Triangle	*Cube
	Large	Large	Large	Large
	Striped	*Striped	Plain	Dotted
Set 24.	Yellow	Yellow Green	Yellow	Rose
	Sphere	Triangle	Cube	*Sphere
	Medium	Medium	*Medium	Medium
	Dotted	*Dotted	Striped	Plain

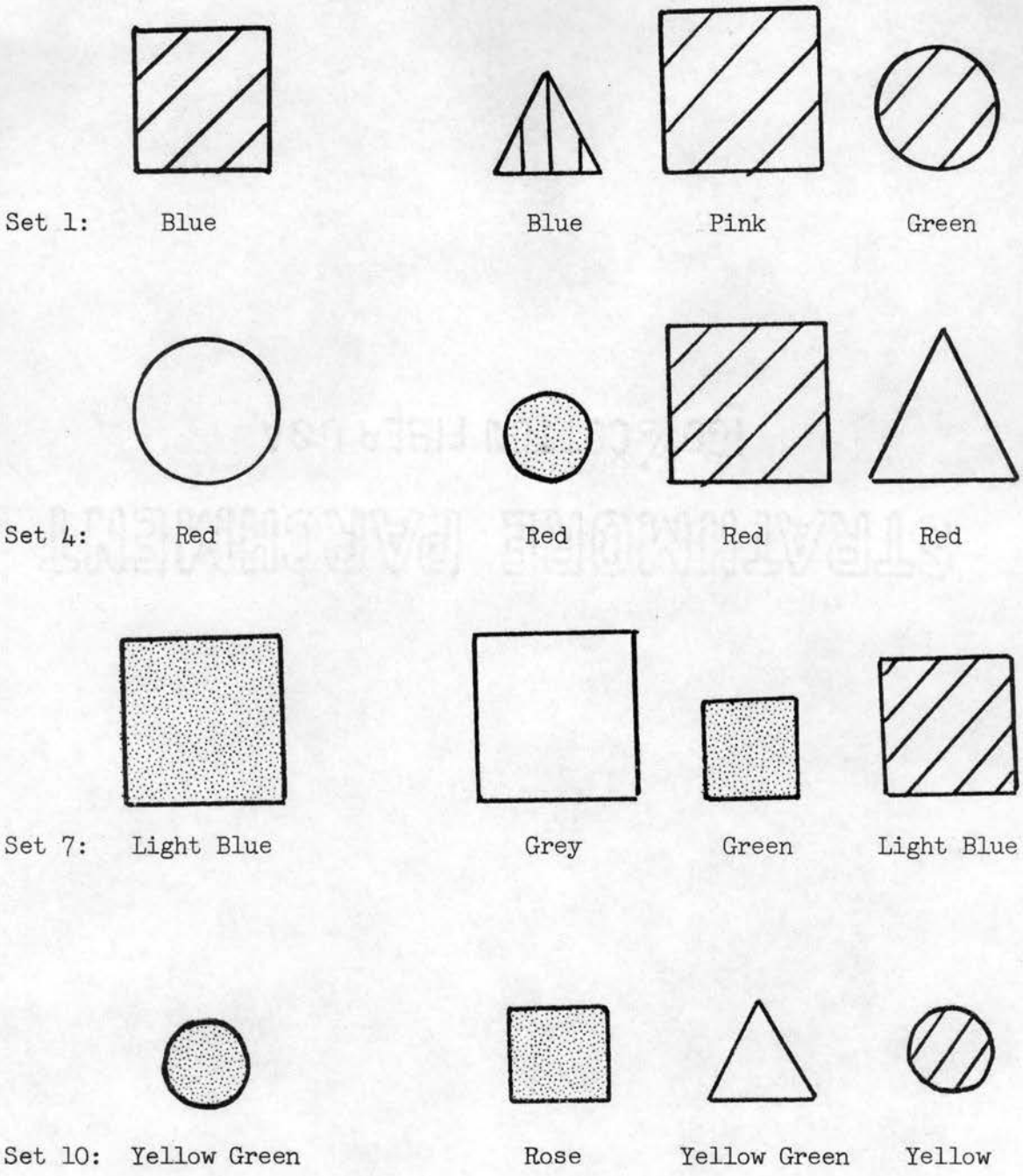


Figure 2. Illustrations of Pretest Matching Objects

Training Task

The purpose of the training task is to teach the child how to make correct responses in a game which requires him to choose between two alternatives. These alternatives are based on three dimensions: brightness, form, and size.

The apparatus for the task is a green turntable one foot square, divided in half by a partition five inches high. On each side of the partition are two holes in which a reward object (a small beaded peg) can be placed. These holes, two inches square and three inches apart, are covered by lids on which the stimulus objects made of styrofoam are fastened. Thus, when the child makes his choice between the two stimulus objects, he picks up one of the objects and uncovers one of the holes. If he makes a "correct" choice, he finds a reward; but if he makes an "incorrect" choice, he finds nothing.

The stimulus objects are 16 paired objects differing in brightness (A: black and white), 16 paired objects differing in form (B: square and cylinderical), and 16 paired objects differing in size (C: large and small). The black, the square, and the large in these paired objects are the positive stimuli which constitute the correct responses in the training task.

The training task is administered in two ways. In one method of training, in which the three dimensions are presented in a random order (e.g., A-B-C, B-C-A), the child simultaneously learns the correct responses to all three dimensions. This method of presentation is assumed to instigate reflective behavior. In the other method of training, the child learns the correct response to the brightness dimension (A),

before the next dimension is introduced. This method of presentation is assumed to instigate impulsive behavior.

The following directions are used to explain the task to the child: "This is the game we're going to play. I'm going to put a peg in one of these holes; and then I'm going to cover the holes with a black cover and a white cover. You get to look for the peg; and if you find it, you can put it over here in your peg board. Let's see if you can find a peg everytime."

After the initial directions, the child's attention is called to the relative dimensions of each pair of objects for the first three times each dimension appears in the task. Then the experimenter makes no comment as long as the child's responses are correct. After an incorrect response on any one of the dimensions, the experimenter again verbally calls the child's attention to that dimension the next time it appears in the task. For example, if the child responds incorrectly to a pair of objects distinguished by size, the next time size is the dimension, the experimenter says, "Here's a big one and a little one."

For both methods of training, the criterion for learning is nine correct responses out of ten. Applied to one method of training, this means that the random presentation of all three dimensions continues until the child responds correctly to each dimension nine times out of ten. Applied to the other method of training, this means that one dimension is presented until the child responds correctly nine times out of ten, and then the next dimension is introduced. For each method of presentation the scoring is a simple count of the number of trials required to reach the criterion for learning.

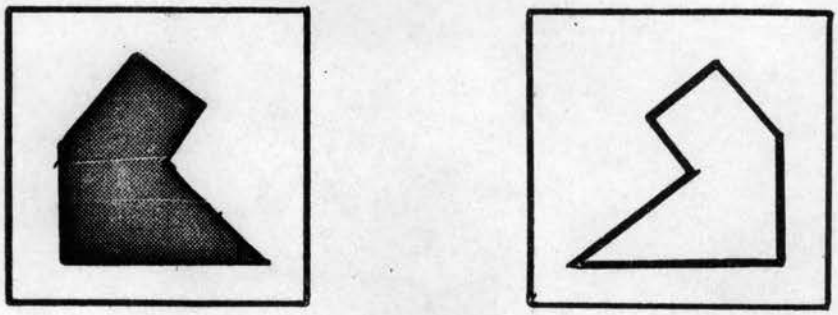
Reversal Shift Task

The purpose of the reversal shift task is to measure the influence of chosen methods of training on children's tendency toward impulsive or reflective behavior. Specifically, the reversal shift task provides a problem solving situation in which a change in a learned response is required and the children's ability to make the change is measured.

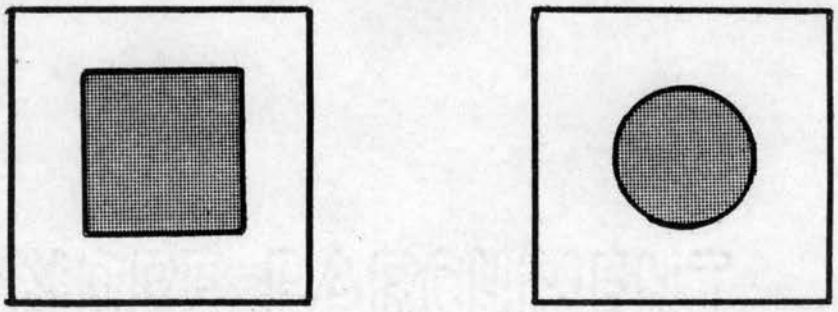
For this task the apparatus and stimulus objects are the same as those used in the training task; however, the stimuli which were "incorrect" in the training task are the "correct" stimuli in the reversal shift task. (The white, the cylinderical, and the small are the positive stimuli which constitute the correct responses in the reversal shift task.)

The reversal shift task is administered immediately after the training task. The experimenter explains, "Now we're going to play a new game. This time if you pick up the right one, you will find a (different color) peg in the hole." The paired stimuli are then presented in a random order, as in one method of presentation for the training task.

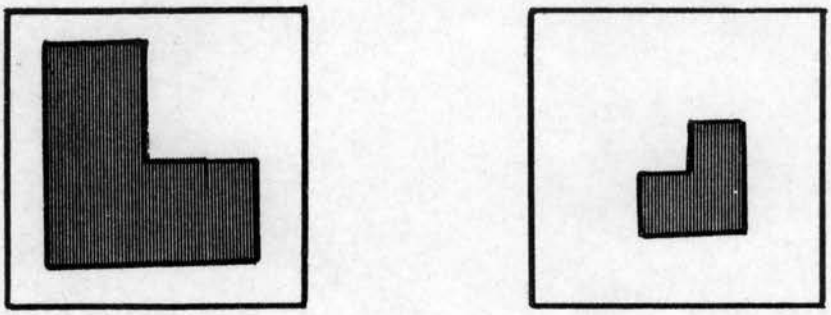
In the reversal shift task, the child's score is a simple count of the number of incorrect responses made in a series of 30 reversal shifts.



A. Black White



B. Square Cylinderical



C. Large Small

Figure 3. Illustrations of Training and Reversal Shift Stimulus Objects

APPENDIX B

TABLE I

AGE, SEX, AND PRETEST RAW SCORES OF EXPERIMENTAL AND CONTROL CHILDREN PARTICIPATING IN A STUDY OF RIGIDITY AND FLEXIBILITY IN PROBLEM SOLVING

Experimental Group						Control Group					
		Pretest Scores						Pretest Scores			
Child*	Age	Color	Form	Size	Pattern	Child	Age	Color	Form	Size	Pattern
400-M	3:11	15	3	0	6	582-F	3:11	18	0	0	6
552-F	4:5	18	0	0	6	180-F	4:6	16	2	1	5
837-F	4:8	18	0	1	5	427-F	4:8	18	0	1	5
707-M	4:10	18	2	0	4	690-F	4:11	16	0	0	8
838-M	4:11	17	2	0	5	779-M	4:10	14	0	3	7
593-F	5:1	18	0	0	6	592-M	5:3	16	0	2	6
12-M	5:3	2	14	3	5	692-M	5:4	3	15	0	6
652-F	4:0	3	5	9	7	649-M	3:11	5	5	7	7
688-F	4:3	4	12	7	1	651-M	4:0	3	13	5	5
579-M	4:4	12	5	5	2	844-M	4:5	11	7	2	4
601-F	4:7	12	1	1	10	576-F	4:7	12	2	0	10
687-F	4:9	9	5	2	8	553-M	4:11	12	3	0	9
573-M	4:10	4	8	6	6	840-F	4:8	7	9	2	6
560-F	5:2	12	4	2	6	486-F	5:0	10	6	3	5
839-M	5:1	7	12	2	3	590-M	5:2	10	10	1	3
131-M	5:1	7	7	6	4	600-M	5:4	4	8	9	3

*Identified by sex and code number.
First seven listed, classified as rigid; last nine listed, classified as flexible.

TABLE II

RAW SCORES OBTAINED BY EXPERIMENTAL AND CONTROL CHILDREN ON A TRAINING TASK AND A REVERSAL SHIFT TASK IN A STUDY OF RIGIDITY AND FLEXIBILITY (N=32)

Experimental Group			Control Group		
Child*	Training Task**	Reversal Shift***	Child	Training Task	Reversal Shift
400-M	33	7	582-F	34	12
552-F	96	3	180-F	31	7
837-F	48	3	427-F	30	18
707-M	72	5	690-F	30	11
838-M	69	15	779-M	34	4
593-F	75	2	592-M	30	5
12-M	33	5	692-M	31	6
652-F	63	3	649-M	30	8
688-F	48	10	651-M	62	5
579-M	48	6	844-M	30	9
601-F	60	7	576-F	39	7
687-F	63	1	553-M	40	9
573-M	89	9	840-F	44	12
560-F	39	9	486-F	39	18
839-M	60	11	590-M	38	6
131-M	66	1	600-M	50	16

*Identified by sex and code number
**Number of trials to reach criterion
***Number of incorrect responses

First seven listed, classified as rigid; last nine listed, classified as flexible.

VITA

Linda Sue Geurkink

Candidate for the Degree of

Master of Science

Thesis: A STUDY OF RIGIDITY AND FLEXIBILITY IN PRESCHOOL CHILDREN'S BEHAVIOR IN A PROBLEM SOLVING SITUATION

Major Field: Family Relations and Child Development

Biographical:

Personal Data: Born in Oklahoma City, Oklahoma, August 17, 1942, the daughter of Walter and Minnie Geurkink.

Education: Attended grade school in Chickasha, Oklahoma; graduated from Chickasha High School in 1960; received the Bachelor of Science degree from Oklahoma College for Women, with a major in Vocational Home Economics, in May 1963; completed requirements for the Master of Science degree in August 1965.

Professional Experience: Home Economics teacher, Cleveland, Ohio, 1963-64; Graduate Assistant, Department of Family Relations and Child Development, Oklahoma State University, 1964-65.

Professional Organizations: American Home Economics Association, National Association for the Education of Young Children, Oklahoma Academy of Science.