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ABSTRACT

Examined were the effects of verbal labels alone and in combination with two types of instruction on the concept attainment of 80 educable mentally retarded and 80 normal boys of school age matched for mental age. For learning the concept "equilateral triangle" Ss were randomly assigned to one of four experimental treatment conditions: verbal labels and instruction on pentagon labels, verbal labels and instruction on equilateral triangle labels, verbal labels only, and verbal labels and instruction on cutting tool labels (control). Administered was the Equilateral Triangle Test Battery, with subtests measuring concrete, identity, and classificatory concept attainment. Analysis of test scores indicated the following findings: (1) as hypothesized, boys of higher mental age performed better than boys with lower mental age; (2) as hypothesized, there was no significant difference in the mean scores of the educable retardates and normal Ss; (3) the hypothesized treatment effect was found only for the vocabulary measure of the formal level subtest; and (4) the normal boys performed at the classificatory level while the retardates did not. Included in the eight appendixes are drawings of stimulus materials, samples of instructional lessons, and teacher evaluation forms. (Author/CL)

Technical Report No. 301

THE EFFECT OF LABELS ONLY AND LABELS WITH INSTRUCTION ON THE CONCEPT ATTAINMENT OF EDUCABLE MENTALLY RETARDED AND NORMALLY DEVELOPING BOYS OF SCHOOL AGE

Report from the Project on Children's Learning and Development

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STATEMENT OF FOCUS

Individually Guided Education (IGE) is a new comprehensive system of elementary education. The following components of the IGE system are in varying stages of development and implementation: a new organization for instruction and related administrative arrangements; a model of instructional programing for the individual student; and curriculum components in prereading, reading, mathematics, motivation, and environmental education. The development of other curriculum components, of a system for managing instruction by computer, and of instructional strategies is needed to complete the system. Continuing programmatic research is required to provide a sound knowledge base for the components under development and for improved second generation components. Finally, systematic implementation is essential so that the products will function properly in the IGE schools.

The Center plans and carries out the research, development, and implementation components of its IGE program in this sequence: (1) identify the needs and delimit the component problem area; (2) assess the possible constraints--financial resources and availability of staff; (3) formulate general plans and specific procedures for solving the problems; (4) secure and allocate human and material resources to carry out the plans; (5) provide for effective communication among personnel and efficient management of activities and resources; and (6) evaluate the effectiveness of each activity and its contribution to the total program and correct any difficulties through feedback mechanisms and appropriate management techniques.

A self-renewing system of elementary education is projected in each participating elementary school, i.e., one which is less dependent on external sources for direction and is more responsive to the needs of the children attending each particular school. In the IGE schools, Center-developed and other curriculum products compatible with the Center's instructional programing model will lead to higher morale and job satisfaction among educational personnel. Each developmental product makes its unique contribution to IGE as it is implemented in the schools. The various research components add to the knowledge of Center practitioners, developers, and theorists.

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ABSTRACT

Eighty educable mentally retarded and 80 normally developing boys of two different mental age levels participated in the experiment. The main objective of the study was to ascertain the effects of verbal labels alone and verbal labels with two kinds of instructions on concept attainment. The concept assessed was that of equilateral triangle. The boys within each mental age level of each classification were randomly assigned to one of four experimental treatment conditions:

I. verbal labels + instruction on pentagon labels

II. verbal labels + instruction on equilateral triangle labels

III. verbal labels only

IV. verbal labels + instruction on cutting tool labels (control)

Upon completion of the instruction in each treatment, the boys were given five subtests of the Equilateral Triangle Test Battery. This battery has one subtest for each of three successively higher levels of concept attainment (concrete, identity, and classificatory) and two subtests (attribute discrimination and vocabulary) for attainment at the formal level which is the highest level. Thus the dependent measures were the total number of items correct on the five subtests.

An analysis of the test scores indicated that, as hypothesized, boys of higher mental age performed significantly better than boys of lower mental age on all five tests. Also, as hypothesized, a significant difference in the mean scores of the educable retardates and normal subjects was not observed on any of the measures. The hypothesized treatment effect

was found only for the vocabulary measure of the formal level subtest; however, two significant interactions were also observed, normal/EMR x treatment on the classificatory level subtest and MA x treatment on the vocabulary measure of the formal level subtest. The normally developing boys performed at the classificatory level as hypothesized, the mentally retarded did not. The interaction involving vocabulary resulted primarily from the performances of the high and low MA boys. The results were discussed in terms of possible educational implications.

Chapter 1

INTRODUCTION

School-age children, both normal and exceptional, have long been the focal point of the research activities of educational psychologists. One area of concern that has received a great deal of attention by psychologists is that of concept learning. For the past few years a major endeavor at the Wisconsin Research and Development Center for Cognitive Learning has been to understand the processes involved in children's concept learning.

Knowledge about concept learning is incomplete. This may be attributed to the fact that concepts are complex and that many operational definitions of concepts are used in various experiments.

Vinacke (1951), defines a concept as,

> . . . selective mechanisms in the mental organization of the individual, tying together sensory impressions, thus aiding in the identification and classification of object, . . . they are linked with symbolic responses which may be activated without the physical presence of external objects, . . . concepts can be names -- can be detached from specific instances . . . and used to manipulate experience over and beyond the more simple recognition function [p. 5].

Bruner, Goodnow, & Austin (1956), define a concept as,

> . . . a network of sign-significant inferences by which one goes beyond a set of <u>observed</u> critical properties exhibited by an object or event in question, and thence to additional inferences about other unobserved properties of the object or event [p. 244].

For the purposes of the present discussion, the writer will use the definition developed by Klausmeier, Ghatala, & Frayer (in press). The

term concept is used:

> to designate both mental constructs of individuals and also identifiable public entities that comprise part of the substance of the various disciplines. Thus, the term concept is used appropriately in two different contexts . . . we define a concept as ordered information about the properties of one or more things -- objects, events, or processes -- that enables any particular thing or class of things to be differentiated from, and also related to, other things or classes of things [in press].

The Wisconsin model of conceptual learning and development (Klausmeier, Ghatala, & Frayer, in press) provides the necessary theoretical framework for the present study. The Wisconsin model delineates four invariant and successive levels of obtaining the same concept. The four levels are concrete, identity, classificatory, and formal. The levels differ in both inclusiveness and level of abstraction. Each level presumes mastery of the preceding level. Figure 1 represents an overview of the structure of the model.

Examination of the model indicates that in order to attain a concept at the concrete level, an individual must be able to attend to, discriminate, and remember the stimulus that was discriminated. Furthermore, the same operations need to be present for attainment of a concept at each of the successively higher levels. The additional higher level operations necessary for attaining a concept at the identity, classificatory, and formal levels are the operations of hypothesizing, evaluating, and generalizing. It is noted that as the learner progresses from one attainment level to another what is operated on and remembered changes. "That is, the operations are carried out on more sharply differentiated and abstracted stimulus properties at the four successive levels [Klausmeier, et al., in press]."

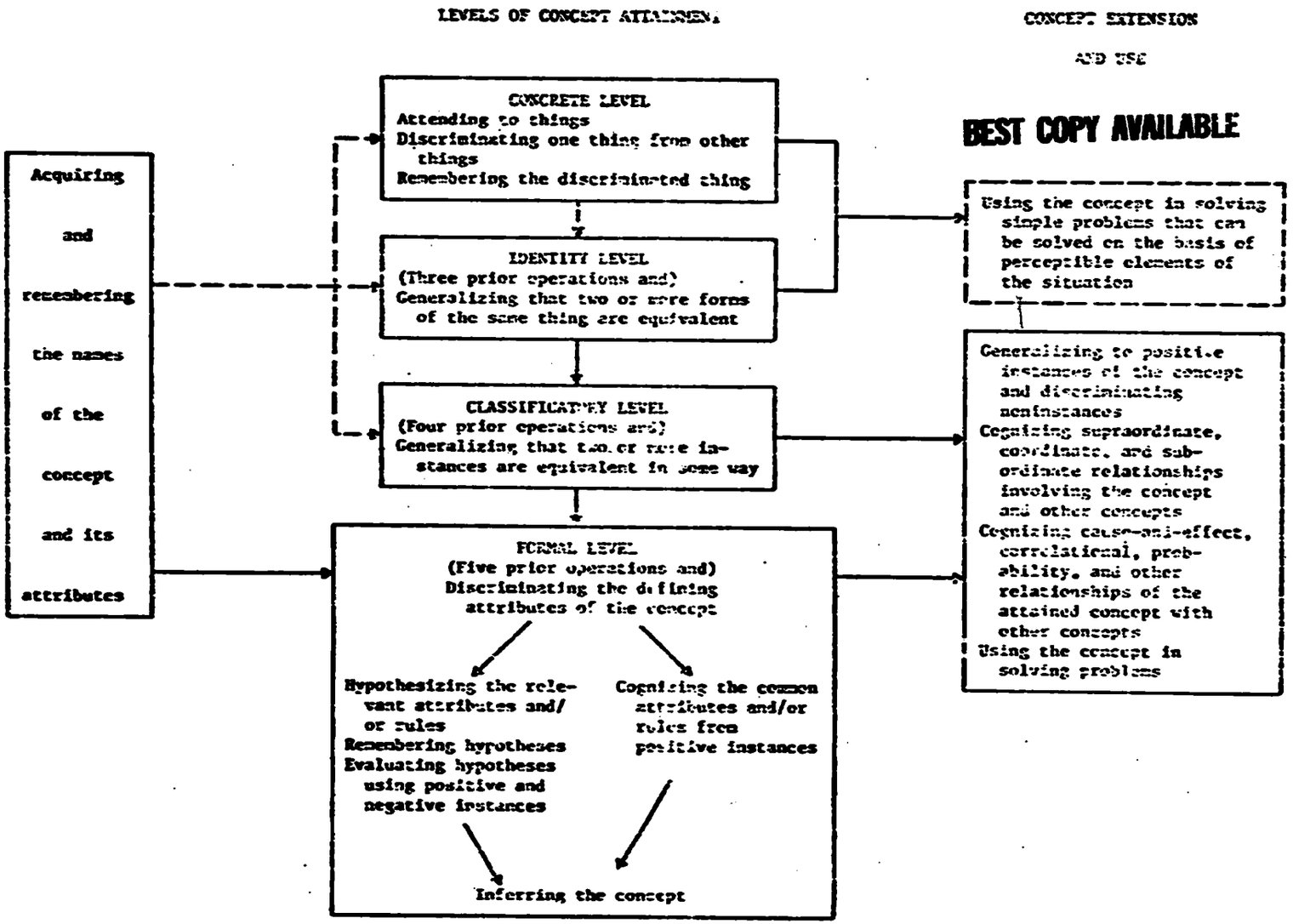


Figure 1. Cognitive operations in concept learning. (Source: Klausmeier, H., Ghatala, E., & Frayer, D. Conceptual learning and development: A cognitive view. New York: Academic Press, in press.)

A more detailed examination of the model indicates the operations required for attaining a concept at each of the four levels. Attainment of a concept at the concrete level necessitates that an individual "cognize an object that he has encountered on a prior occasion [Klausmeier, et al, in press]."

The object is usually a physical object but need not be so, it may be a representation of the object. In order for mastery to occur at the concrete level, an individual must attend to the object, perceive the distinguishing characteristics of the stimulus and remember the distinguishing characteristics. "The concept at this level may or may not be associated with the concept label, depending on whether it has been associated with the concept [Klausmeier, et al., in press]."

Concept attainment has been reached at the second level, i.e., identity level, when the individual can "cognize an object as the same one previously encountered when observed from a different perspective or sensed in a different modality [Klausmeier, et al., in press]." The additional operation which distinguishes the identity level from the concrete level is that an individual not only discriminates various forms of the stimulus object from other objects, but also generalizes various forms of the object as being equivalent.

At the classificatory level, concept attainment is assumed when an individual is able to "respond to at least two different instances of the same class as equivalent even though he may not be able to describe the basis for his response [Klausmeier, et al., in press]." Attainment at this level incorporates the operations present at the two lower levels plus one additional operation. The operation requires that an individual

must now generalize to at least two different instances as being equivalent in some manner.

Attainment of a concept at the formal level is inferred when an individual "can give the name of the concept, can name its intrinsic or societally accepted defining attributes, can accurately designate instances as belonging or not belonging to the set, and can state the basis for their inclusion or exclusion in terms of the defining attributes [Klausmeier, et al., in press]." At this, the highest level of concept attainment, an individual must be able to name the concept and label its defining attributes. While it is not necessary that the learner be able to provide the concept labels and labels for the defining attributes at the three lower levels of concept attainment (concrete, identity, and classificatory), it is a requisite for concept attainment at the formal level. Furthermore, the learner is also expected to be able to "differentiate among newly encountered instances and noninstances on the basis of the presence of absence of the defining attributes [Klausmeier, et al., in press]."

Thus we see that the operations of discriminating the attributes and being able to provide the appropriate labels for the attributes is essential for concept attainment at the formal level. This is a necessity whether the learner infers the concept from cognizing the common attributes from positive instances, or through evaluating and hypothesizing about the relevant attributes. The type of strategy employed by an individual will depend upon his age, the kind of instructions he received, and his experiences with the concept (Klausmeier, et al., in press).

The model further presumes that the individual who attains a concept

only to the concrete or identity level may extend and use the concept in solving simple, perceptually-based problems. Furthermore, once the individual acquires a concept at either the classificatory or formal level it may be extended and used in cognizing supraordinate-subordinate relationships, and cause-and-effect or correlational relationships. The concept may also be used to generalize to positive instances and discriminate noninstances, and in problem-solving situations.

Purpose

The mentally retarded child has been characterized as being qualitatively and quantitatively different from his normal peers in conceptual ability. Cutts (1959), writes,

> There is no question but what the range of ability in conceptualization is much narrower with the defective mentally retarded child than with the average or superior, and the generally lower capacity is one of the aspects of intellectual functioning of this child that differentiates him qualitatively as well as quantitatively from the child within the average or above range [p. 317].

The present study investigated this difference in terms of the model of concept learning developed by Klausmeier and others (in press) at the Wisconsin Research and Development Center for Cognitive Learning. The present experiment is unique in that it is the first attempt to use the tests of the Wisconsin model of cognitive operations for assessing level of concept attainment on a population of educable mentally retarded subjects. Furthermore, the present study was designed to provide direct information regarding concept attainment of educable mentally retarded children and indirect information regarding the applicability of the tests.

The purpose of the present study was to investigate the effects of verbal labels alone and verbal labels with two kinds of instructions on the concept attainment of educable mentally retarded and normal male subjects of the same mental age.

The specific questions which the experiment sought to answer were:

1. What is the effect of normal vs. retarded mental development on concept attainment?

2. What is the effect of higher vs. lower mental age on concept attainment?

3. What is the effect of various kinds of instruction on concept attainment?

4. Is there an interaction between level of mental age and normal vs. retarded mental development?

5. Is there an interaction between kinds of instruction and normal vs. retarded mental development?

6. Is there an interaction between kinds of instruction and higher vs. lower mental age?

7. Is there an interaction among kinds of instruction, normal vs. retarded mental development, and higher vs. lower mental age?

Based upon the preceding questions, the following hypotheses are offered for each of the three main-effect questions.

1. There will be no difference between normally developing and mentally retarded boys on concept attainment.

2. Higher MA boys will perform significantly better than lower MA boys on concept attainment.

3. The rank order of the treatments from lowest to highest will be control, verbal labels only, verbal labels with instruction pertaining to pentagon, and verbal labels with instruction pertaining to equilateral triangle; also the last two treatments will result in significantly higher concept attainment that th· control group.

No hypotheses are entertained for questions 4-7.

Method

A pilot study was conducted to assure that lessons and other experimental procedures functioned properly with a target sample of subjects. The methodology of the main study was based upon the results of the pilot study.

The subjects of the main study consisted of 80 educable mentally retarded (EMR) boys and 80 normal boys chosen from various schools within the Milwaukee Public School system. Subjects within each classification were stratified into high and low MA levels based upon the results of standardized test scores. The subjects at each MA level of each classification were then randomly assigned to one of four treatment conditions. These included:

I. verbal labels + instruction on pentagon labels

II. verbal labels + instruction on equilateral triangle labels

III. verbal labels only

IV. verbal labels + instruction on cutting tool labels (control group)

Upon completion of the treatments, the subjects received a battery of Center developed tests on the equilateral triangle (Klausmeier, Ingison, Sipple, & Katzenmeyer, 1972). Performance on the levels subtests of this

battery was used as the dependent measure. The treatments and subsequent dependent measures were administered in small groups as necessary to be appropriate for the subjects' mental age.

(The original intent of the experimenter was to conduct analyses on the subtests for each of the four levels of concept attainment and on the two uses subtests of the attained concept. Upon obtaining very low reliability coefficients for the uses subtests, the analysis of these results was discontinued. Therefore, the analyses were conducted on the subtests of each of the concrete, identity, and classificatory levels, and two subtests of the formal level of concept attainment.)

The stratifying variables of mental age and classification (i.e., EMR or normal) and the independent variable of kind of instruction resulted in a 2 x 2 x 4 completely crossed design with fixed effects. Five analyses of variance were carried out to determine the effects of level of mental age, EMR vs. normal classification, and instructions for performance according to the levels of concept attainment. Post-hoc analyses were conducted using Tukey's (1949) procedure for pairwise comparisons.

Significance of the Study

The present experiment was designed to study the effects of verbal labels alone and also verbal labels with two kinds of instructions on the concept attainment of EMR and normal boys of the same mental age. The results may therefore have implications for curriculums designed for use with educable mentally retarded children. Furthermore, the present study was conducted to extend knowledge about the effects of verbal labels (with or without instructions) in concept learning.

Chapter II

REVIEW OF RELEVANT RESEARCH

The purpose of chapter II is to provide a definition of mental retardation and to describe the educable mentally retarded child. The relationship between language and the conceptual learning and development model (CLD) is examined along with a review of relevant studies ascertaining the effects of verbal labels on concept learning.

Mental Retardation Defined

The study of the mentally retarded child has been an area of interest to both educators and psychologists alike ever since Jean Itard began educating the Wild Boy of Aveyron in the 19th century. With the increased interest in the study of the mentally retarded, numerous definitions from many different perspectives have emerged. Definitions differ according to the orientation of the writer. Some have their foundation in medical and psychological terminology while others approach mental retardation from a social or legal perspective. For example, an early investigator in the area, Tredgold (1937), defined mental retardation in terms of the degree of social adequacy. Tredgold defined mental retardation as

> a state of incomplete mental development of such kind and degree that the individual is incapable of adapting himself to the normal environment of his fellows in such a way to maintain existence independently of supervision, control or external support [p. 4].

Similarly, Benda, almost two decades later, defined mental deficiency in terms of

> a person who is incapable of managing himself and his affairs, or being taught to do so, and who requires supervision, control, and care for his own welfare and the welfare of the community [1954, p. 1115].

Benoit (1959) offers a definition of mental retardation stated in terms of Hebb's (1949) theory of the organization of behavior. Benoit writes:

> a deficit of intellectual function resulting from varied intrapersonal and/or extrapersonal determinants, but having as a common proximate cause a diminished efficiency of the nervous system thus entailing a lessened general capacity for growth in perceptual and conceptual interpretation and consequently in environmental adjustment [p. 561].

Mental retardation has been defined from a psychometric perspective also. This allowed workers in the field who prefer a single-dimension basis to specify a quantitative standard as to who is mentally retarded and who is not. Robinson & Robinson (1965) are of the opinion that this approach allows for

> simplicity, ease of communication, and well-defined normative groups for comparison. Most important, it recognizes that intelligence tests have provided an index of intellectual development which communicates the greatest amount of information about the intellectual status of a child in the least amount of time [p. 31].

Though it may seem advantageous to use a psychometric approach, it must be remembered that such an approach does not take into consideration the fact that an IQ score must be viewed as a point falling on a continuum of mental ability, not as a description of a discrete class of intellectual functioning. Furthermore, it must be remembered that all psychological testing is subject to measurement errors (Robinson & Robinson, 1965).

No one definition will ever gain complete acceptance by all concerned with the study of mental retardation. The definition chosen by the experimenter is the most recent and widely accepted. Published by the American

Association on Mental Deficiency (AAMD), mental retardation is succinctly defined as "subaverage general intellectual functioning which originates during the developmental period and is associated with impairment in adaptive behavior [Heber, 1961a, p. 3]." The key phrase in Heber's definition is "impairment in adaptive behavior." That is, impairment in the individual's ability to adapt to the demands of both the social and natural environment. Impairment in adaptive behavior may be expressed in either learning, maturation and/or social adjustment (Heber, 1961b). Such impairment is related to the age of the individual, i.e., during the school years, the impairment is expressed in terms of learning difficulties while during adulthood, the impairment manifests itself in terms of difficulty with the economic and/or social demands of the environment.

Robinson & Robinson (1965) in analyzing Heber's definition bring to light the following points:

1. The definition is "specifically developmental in approach, . . . the present definition stresses the development and emergence of new facets of human functioning as the individual grows up [p. 35]."

2. The AAMD definition eludicates the idea that "a diagnosis of mental status should be a description of present behavior and specifically disavows the notion of potential intelligence [p. 35]."

3. Heber's formulation of mental retardation relies upon objective tests of intellectual ability. The two most common instruments used to measure intelligence are the Wechsler Intelligence Scales for Children (WISC) and the Stanford-Binet. The AAMD definition combines the mental test score with other indices of performance (e.g., measures of motor skills and social maturity).

Of concern to the present experiment is the educable mentally retarded (EMR) child. Educable mentally retarded children have been defined by Robinson & Robinson (1965) as "having IQs from 50 to 75; they are expected eventually to achieve academic work at least to the third-grade level and occasionally to the sixth grade level by school-learning age . . . [p. 461]." Studies have shown (Bradway, 1935; Sarason & Gladwin, 1958; and Sabagh et al., 1959) that a large majority of mildly or educable mentally retarded children are found in lower, disadvantaged classes. Typically, these children "derive from city slums or environmentally depressed rural areas and present no evidence of pathology of the central nervous system [Heber, 1961b, p. 70]." It has been postulated (Bereiter & Engelman, 1966) that such children are deficient in language development. In their book, Teaching Disadvantaged Children in the Preschool, Bereiter & Engelman state:

> in practically every aspect of language development that has been evaluated quantitatively, young disadvantaged children have been found to function at the level of average children who are a year or more younger. The other area in which disadvantaged children seem to be especially retarded is reasoning ability or logical development. Here, too, the amount of retardation is typically a year or more. Verbal and reasoning ability, which may be combined under the general rubic of ability to manipulate symbols, have been found to be the major factor in academic achievement throughout the school years [pp. 5-6].

It would appear that one could legitimately conclude that the educable mentally retarded child is deficient in language development.

Before examining the effects of verbal labels on concept learning, it is deemed appropriate to review the relationship between language and concept attainment.

Language and the Conceptual Learning and Development Model

It will be remembered from the discussion presented in chapter I that language and the conceptual learning and development (CLD) model are definitely interrelated. Language plays an increasingly important role as one progresses from one level to the next hierarchical level. While it is not necessary that the learner be able to provide the concept labels and labels for the defining attributes (though they may be acquired) at the three lower levels of concept attainment (concrete, identity, and classificatory), it is a prerequisite for concept attainment at the formal level. It is quite possible for an individual to acquire a concept at the concrete, identity, or classificatory level based solely upon perceptible instances. At the formal level though, concept attainment necessitates that the learner knows the concept labels and its attributes besides being able to provide a definition of the concept in terms of its attributes (Klausmeier, Natala, & Frayer, in press).

"Language can facilitate concept learning or indeed be the medium through which many concepts are acquired [Klausmeier, et al., in press]." Since language is related to conceptual learning, it seems appropriate to examine the influence of language at each of the four levels of concept attainment. First though, there is a function of language which serves to influence all of the levels of concept attainment. Specifically, "one function of linguistic forms is to provide a cue for the formation of a new concept [Carroll, 1964, p. 90]." For example, if an adult informs a child about a unicorn, the child is alerted to the possibility that there exists such a class of experience. Further explanation and description fix the boundaries of this class of experiences (Carroll, 1964).

1. The Concrete Level

Attainment of a concept at the concrete level requires that a learner (1) attend to things, (2) be able to discriminate one thing from another thing, and (3) remember the discriminated thing, i.e., an object or event.

Attending is a process fundamental to all of concept learning. The operation of attending may be influenced by language, i.e., verbal instructions. For example, a parent telling a child "look at the dog" directs the child's attention to that class of experiences known as "dog". "One of the most important forms of training a child receives is making varied attentional responses under the control of verbal instructions [Klausmeier, et al., in press]."

What is the function of language, i.e., verbal labels, on discrimination learning at the concrete level? One of the earliest reported studies investigating the effects of verbal labels on discrimination behavior is a 1934 study by Pyles. Pyles' experiment investigated the influence of verbal symbols in the development of form discrimination. The subjects were 80 nursery school, kindergarten, and first grade children. Using a matching process based upon CA, MA, sex, and school, subjects were assigned to six equivalent groups and asked to solve a series of three discrimination problems. The stimulus materials of series A and series B consisted of five three-dimensional nonsense forms. Series C consisted of five familiar animal forms (cat, dog, rabbit, bear, and monkey). Subjects assigned to series A were not supplied with names for the nonsense forms while series B subjects were supplied with "nonsense names" (e.g., Mobie, Tito, Kolo, Gamie, and Bakie) and encouraged to use the names while searching for reward items concealed within the forms. Series C subjects were generally able to spontaneously name the animal forms.

All subjects received 25 trials daily until a criterion of four correct choices was established on 100 trials. Presentation of the three series was counterbalanced for each of the six groups. As far as possible, subjects were tested on the same series two days apart. Testing on each of the remaining series was initiated two weeks after the completion of the previous series.

> The solution of the problem in each of the three series is dependent on the child realizing that the toy is always under the same object, and his being able to recognize the "correct" object as such from among the others. After a child has solved one of the problems, he knows on the two succeeding series that the toy is always to be found under some object [Pyles, 1932, p.110].

In analyzing her data, Pyles discovered that series A was the most difficult (mean trials to criterion, 21.3), series B was the second most difficult to learn (mean trials to criterion, 14.2), and series C was the easiest (mean trials to criterion, 5.3). Pyles interpreted her results as indicating that the observed difference is attributed to the verbalization of the nonsense names.

Prehm (1964) in astutely analyzing Pyles' experiment believes that Pyles' data analysis is incomplete and that an additional interpretation was thereby overlooked.

> In her analysis of the data she seemingly ignored looking at the effects of learning names for the nonsense stimuli of series one, on learning series two, when series two consisted of nonsense forms similar to those of series one. She indicated that in the unnamed series, 13 of the children spontaneously verbalized the correct name from series one, and that the mean number of trials to criterion for these Ss was considerably less than for the other Ss. In her analysis of her data however, she chose to ignore the difference. This seemingly insignificant data would seem to indicate that some average or above average children can transfer a learned skill (object naming) to a new set of stimuli, even after a delay of two weeks, and that this transfer positively affects subsequent discrimination and performance [p. 16].

Pyles' interpretation that facilitation of performance was indicative of the positive value of verbalization was called into question many years later by Kurtz (1955). Kurtz posits that the verbal pretraining actually results in the establishment of an observing response which transfers into the second task. "It follows that when an observing response generalizes from one learning task to another, positive or negative transfer will be obtained according to whether the distinguishing characteristics in the two tasks are the same or different [p. 284]."

Kurtz compared the performance of 40 adult subjects on a paired associate learning task following three types of familiarization training. Kurtz confirmed his hypothesis that different kinds of pretraining result in varying degrees of positive and negative transfer. The results were interpreted as supporting the contention that the function of verbal pretraining is to establish observing responses.

Kurtz's interpretation of his results was given experimental test by Norcross & Spiker (1957). Norcross & Spiker tested the hypothesis that verbal labels produce facilitation on a discrimination task that is greater than can be accounted for in terms of observing responses. Seventy preschool children of two CA levels were randomly assigned to each of three pretraining groups. Subjects were pretrained on a pair of pen and ink sketches. Pair A were female faces and pair B were male faces. The two female faces were named "Jean" and "Peg" while the pair of male faces were labeled "Jack" and "Pete". (A more complete description can be found in Cantor, 1955.) The pretraining groups differed with respect to pretraining experience. Group R learned the names "Jean" and "Peg" for the female faces, group I learned the names "Jack" and "Pete" for the male faces. Subjects

assigned to group D also learned to respond to pair A. These subjects were taught to say "same" or "different" depending upon whether or not the faces were identical. Subjects in each group received pretraining until a criterion of 12 correct responses was established. (The pretraining procedure is very similar to Cantor's 1955 study. The exception was that subjects in group D were required to say "same" when the stimuli were identical and "different" when they were different.)

Upon completion of the pretraining trials subjects were administered 30 transfer tasks. The two female faces (pair A) served as the stimuli. The faces were mounted on small wooden cues. Subjects were told that they would find a marble underneath the box if they chose the correct box. For each subject there was one arbitrarily correct face.

Analysis of the data indicated that group R performed significantly better than either group I or group D. The performance of groups I and D did not differ significantly. The results of Norcross & Spiker confirm previous findings (e.g., Cantor, 1955) that the "possession of verbal labels for the stimuli in a learning task will produce superior performance on that task [p. 83]." Furthermore, Norcross & Spiker are of the opinion that the obtained results cannot be entirely attributed to the development of observing responses.

Norcross (1958) conducted a two-part experiment investigating the hypothesis that "facilitation in a transfer task may be predicted as an increasing function of the distinctiveness of the response-produced stimuli [p. 305]." That is, facilitation produced by the naming of the stimuli is related to the distinctiveness of the verbal labels. Norcross therefore predicted that subjects who learned dissimilar labels for the

test stimuli would exhibit superior performance on a transfer task as compared to subjects who learned similar labels.

Experiment I required 30 kindergarten children. These subjects were randomly assigned to one of two pretraining groups. The experimental stimuli consisted of photographs of two pair of pen and ink drawings of Indian children; one pair of boys' faces and one pair of girls' faces. During pretraining each subject was required to learn either distinctive names ("wug" and "kas") for one pair of faces or similar labels ("zim" and "zam") for the remaining pair. Half of the subjects learned the distinctive names for the boys' faces and half the similar names for the girls' faces. The remaining subjects learned the names in an opposite order. Pretraining required two sessions, one to three days apart. Pretraining on day one continued until the subject was able to name all four photographs correctly. Day two criterion continued until one errorless naming trial was obtained. Immediately upon reaching criterion the transfer task was begun. The transfer task required the subjects to learn which button was associated with each face. Prior to pressing the button, the subjects were required to pronounce the name of the face. Fifteen transfer trials were presented in a random order. As Norcross predicted, analysis of the data revealed that subjects who learned dissimilar names performed significantly better (i.e., greater number of correct responses) than subjects who learned similar names.

A significant difference between naming errors for the similar vs. dissimilar group prompted Norcross to conduct a second experiment. Experiment II differed from experiment I in that during transfer, subjects were corrected for incorrect naming and were required to verbalize the correct name prior to pushing the button.

Experiment II required that 26 subjects be randomly assigned to one of two subgroups. As in experiment I, transfer performance for subjects assigned to the dissimilar name condition was superior to that of subjects assigned to the similar name condition.

Norcross notes that the design does not permit one to ascertain whether transfer was positive, negative or both. Norcross concludes that this study "suggests that, under certain conditions, the transfer effects depend at least in part upon the degree of generalization among the response-produced stimuli [p. 308]." Furthermore, Norcross holds to the premise that the observed effects cannot be attributed to the formation of observing responses.

Further evidence of the positive effects of verbal labels on discriminative responding to stimuli is evidenced by an experiment by Katz (1963). Katz conducted a three stage experiment using 48 seven and nine year old children to examine the hypothesis that "the nature of verbal labels associated with stimuli influences the subsequent perception of those stimuli [p. 423]." The three stages were as follows, (1) verbal training in which subjects learned to associate four irregularly shaped stimulus figures with four nonsense syllables; RIC, JAN, SOL, and BUZ. Three experimental conditions comprised the initial stage. Subjects assigned to condition A (common-label group) were taught to associate two randomly selected syllables with the four figures. Condition B (distinctive label group) required subjects to associate a different nonsense syllable with each stimulus figure. In the third condition, condition C, (no-label group) subjects examined the figures without receiving labels. The four figures were presented to the subjects individually via a slide projector. Each slide was

shown for two seconds during 150 randomly determined trials. (2) The second stage involved a perceptual task which required all subjects to make "same" or "different" judgments on 28 nonsense figures which were presented for two seconds via a tachistoscope. The slides consisted of eight pairs of identical forms and 20 pairs of two different forms. This is an important part in the design of the study for it allows one to determine what effect (if any) the labels had on the perceptual process rather than counting the number of correct or incorrect responses during the discrimination stage (Stevenson, 1972). (3) The third stage consisted of a series of discrimination learning tasks. Three stimulus figures were involved, two of which were previously associated with a common label for subjects in the common-label group. The reinforced stimulus was always from this group. The criterion was either five consecutive correct responses or 50 trials.

An examination of the results confirmed Katz's hypothesis that differences in verbal training would affect performance on perceptual and discrimination learning tasks. Subjects assigned to the distinctive label group more readily judged the stimulus figures as being different and were more efficient in learning a discrimination employing them than were subjects assigned to the common label group. Katz observed that applying common labels to two different stimulus figures not only influenced the difficulty of the required discrimination but also heightened perceptual confusion. The overall findings of this study indicate that "labels influence the perceptual behavior underlying both the judgment of stimulus similarity and discrimination learning [1963, p. 428]."

Katz & Zigler (1969) in conducting an experiment very similar to the Katz (1963) study also found that verbal labels influenced young children's

perceptual judgement.

An examination of the results of the previously cited studies indicates that verbal pretraining does have a positive facilitative effect on discrimination learning. One theoretical interpretation of this finding is the hypothesis of acquired distinctiveness of cues (ADC). Succinctly stated this hypothesis states:

> that learning to respond to similar stimuli with highly distinctive names makes the total stimulus complex embodied in each cue more distinctive. The stimulus complex is viewed as consisting of the external stimulus and the stimuli produced by the distinctive verbal response [Stevenson, 1972, p. 49].

While one cannot accept the acquired distinctiveness of cues hypothesis as the only means of interpreting the results, the studies by Katz (1963) and Katz & Zigler (1969) come as close as any to being critical tests of the ADC hypothesis.

Alternative interpretations are needed for the results can be examined at many different levels. For example, Stevenson (1972) asks if the subjects in the Katz (1963) study <u>really perceived</u> the two stimulus figures as being similar? Did the labels increase or decrease the perceptual differences, or were the observed differences due to verbal rather than perceptual factors?

One possible alternative explanation is provided by the differentiation theory of Gibson & Gibson (1955). These investigators argue that perceptual learning (the increase in sensitivity to previously existing but undetected, or poorly detected stimulation variables), is of critical importance in discrimination learning. In order to learn the labels for the stimuli, the subject must first learn to differentiate among them. Differentiation among similar stimuli requires perceptual learning. The perceptual learning process is assumed to be one of differentiation, i.e.,

the subjects are assumed to see more of what is contained in the stimulus array. The process of perceptual learning is primarily a function of experience, of progressively being able to distinguish features of stimuli which enable the individual to discriminate on a more exacting basis. The Gibsons would therefore state that perceptual learning occurs during label pretraining rather than the verbal labels changing the discriminability of the stimuli.

Despite the present problem of theoretical interpretation, the reported studies do indicate that labels assist in discriminating among stimuli.

Besides attending and discriminating, the additional cognitive operation necessary for attaining a concept at the concrete level is remembering what was discriminated. A legitimate question to ask is, "Does having the labels for the stimuli enhance memory for them?" The influence of labels is generally studied via memory recognition tasks. The role of memory in concept learning has to be examined "as a function of age and other characteristics of the learner, the level of a concept attainment, and conditions of learning [Klausmeier, et al., in press]." Evidence that attaching distinctive verbal labels to stimuli has a facilitative effect on recognition tasks is subject to controversy.

A representative study is one conducted by Ellis & Mueller (1964, Experiment I). Ellis & Mueller tested 240 university subjects to determine the effect of labels on a memory recognition task. Ten subjects were randomly assigned to each of 24 conditions. These investigators used a design varying stimulus complexity, predifferentiation training, and level of practice. (The design incorporated many of the features of Vanderplas

& Garvins' [1959b] study.) The stimulus materials were 16 random shapes, eight 6-point shapes and eight 24-point shapes chosen from a scale developed by Vanderplas & Garvin (1959a). They were photographed and presented via a commercial projector. Pretraining consisted of three types: distinctiveness, equivalence, or observation. Subjects assigned to the distinctiveness training condition were required to learn meaningful labels for each of eight random shapes. The equivalence training condition subjects learned the label "narrow" for four of the shapes and the label "wide" for the remaining shapes. An observation training condition required the subjects to only inspect the shapes and differentiate among them. These subjects were not supplied with labels. Four levels of practice (2, 4, 8, or 16 trials) were also part of the design.

The experiment itself was divided into two parts; predifferentiation training and a multiple shape recognition task in which subjects were required to select from a group those shapes with which they had experience during predifferentiation training. Immediately upon completion of the pretraining session subjects received the recognition test.

In examining their results Ellis & Mueller found that equivalence training resulted in the poorest performance as compared to either the distinctiveness and observation conditions. The resulting interaction of practice and complexity indicated that the facilitating effect of increasing practice was greater for the more complex stimulus shapes. Ellis & Mueller also found an interaction for complexity and type of predifferentiation training. Subjects assigned to observation only condition performed significantly better on the simple stimulus shapes, while those subjects assigned to the labeling condition (distinctiveness condition) performed

better on the more complex forms. "Specifically, the results indicated that attaching distinctive verbal labels to complex shapes facilitated their subsequent recognition . . . [p. 394]."

The results have not always been positive as evidenced by the results of Hake & Ericksen (1956); Vanderplas & Garvin (1959b); and Santa & Ranken (1968). These investigators all reached the same general conclusion, that the learning of labels for novel stimuli does not have an effect on recognition memory for the stimuli. A more detailed examination of the relationship of label pretraining and memory recognition of nonverbal stimuli is presented by Paivio (1971).

A reasonable conclusion to the previously examined studies "appears to be that while verbal labeling of stimuli <u>can</u> enhance recognition in certain situations, it is certainly not a necessary condition for recognition of nonverbal stimuli [Klausmeier, et al., in press]."

Language, specifically verbal labels, has been shown to effect the cognitive operations involved in attaining a concept at the concrete level. Additional operations are involved at the identity and classificatory levels. The effect of language at these levels is considered next.

2. Language and the Identity and Classificatory Levels

Attainment of a concept at the identity and classificatory levels are treated together for it is believed that stimulus labeling will effect both levels in a similar manner (Klausmeier, et al., in press). In addition to the three prior operations, attainment of a concept at the identity level requires that the learner be able to generalize that two or more forms of

the same stimulus are equivalent. That is, an individual must be able to recognize a stimulus as the same stimulus previously viewed despite changes in perspective or other irrelevant details. This involves generalizing or abstracting the relevant from the irrelevant features of the stimulus object.

Concept attainment at the classificatory level incorporates the operations present at the two lower attainment levels plus one additional operation. The additional operation requires that an individual must now generalize to at least two different instances of a concept as being equivalent in some manner. Generalization necessitates abstracting the relevant attributes of the stimulus object while disregarding the irrelevant attributes. "At the classificatory level these attributes may be perceptual properties of instances or they may be nonperceptual attributes [Klausmeier, et al., in press]." Young children are able to classify on the basis of perceptual attributes while older children will exhibit classificatory behavior based upon nonperceptual attributes (Bruner, Olver, Greenfield, et al., 1966).

In summary, concept mastery at the identity level requires that an individual be able to discriminate a stimulus object from other stimulus objects despite changes in its perspective. At the classificatory level an individual must be able to classify instances of stimuli from other instances based upon the similarities between them (Klausmeier, et al., in press).

This investigator is unaware of any studies relating language and the identity level of concept attainment. Studies are available though which do relate labeling and the classificatory level. Due to the similarity of

operations, results from studies examining stimulus labeling at the classificatory level may be extended to the identity level of concept attainment.

Experimental evidence exists which shows the positive effect that verbal label pretraining has on conceptual sorting (Carey & Goss, 1957; and Goss & Moylan, 1958). In the Carey & Goss (1957) experiment, 40 preschool children were assigned to four different label pretraining groups. The stimuli consisted of four circular and four square black blocks which were either tall or short, and large or small. Subjects assigned to the first group learned to pair-associate familiar labels to both blocks of each height-size category. A second group of subjects learned to pair-associate nonsense labels for the same stimuli. Both groups were required to reach a criterion of 7/8 correct anticipations or 12 trials. The investigators controlled exposure to and naming experience with blocks by including a see-discriminate-name (SDN) group in which subjects were instructed to examine each of the eight blocks and to try and guess its name. The SDN group also experienced 12 trials. A control group which had no prior experience with the blocks was also incorporated in the design of the experiment.

Upon completion of pretraining task subjects were exposed to a block-sorting task. Subjects from each of the four conditions were asked to sort the stimulus blocks into four height-size categories. All subjects received 10 trials.

An examination of the pretraining results indicated that while subjects assigned to the familiar label condition were consistently superior to subjects assigned to the nonsense syllable condition, a significant difference in the number of correct responses was not found. Results of

the block-sorting task indicated that subjects who learned familiar words performed significantly better than subjects assigned to either the nonsense syllable, SDN group (no label group), or control group. Carey & Goss interpreted their findings as confirming the hypothesis of positive transfer from verbal pretraining to conceptual sorting, but only when familiar labels are used during pretraining.

Goss & Moylan (1958) using essentially the same procedure as Carey & Goss (1957) "investigated transfer to sorting blocks into height-size categories as a function of degree of mastery of discriminative familiar word or nonsense syllable labels [pp. 191-192]." Goss & Moylan used 150 college students as subjects and increased the number of stimuli from eight blocks to 16 blocks. Color was added as an additional attribute and the number of pretraining trials was varied. Goss & Moylan also added an additional experimental group (instructed group) who were told at the beginning of block-mastering to sort the blocks into categories of tall-large, tall-small, short-large, or short-small. Therefore, the Goss & Moylan study incorporated five experimental groups.

As in the previous experiment (Carey & Goss, 1957), subjects were required to learn either familiar labels or nonsense syllables for the blocks using a paired-associate technique. The block-mastering task required that subjects sort the stimulus blocks into the appropriate height-size category.

The results revealed that subjects who were provided with label pretraining performed better than control subjects. A statistical analysis of the data indicated that

> learning familiar words or nonsense syllables produced more height-size placements than seeing-discriminating-naming or no exposure to the blocks. Specific appropriate instructions, however, resulted in even more height-size placements [Goss & Moylan, 1958, p. 195].

Further examination revealed that as criteria of mastery increased, conceptual sorting performance for both the familiar label and nonsense syllable groups also increased. The experimenter interprets the superior performance of the instructed group as being due to the subjects using the stimulus labels provided in the instructions as verbal mediators throughout the block mastery task.

> The results of the foregoing studies support the hypothesis that acquisition of distinctive labels for stimuli in different categories results in increased intracategory and decreased intercategory similarity of stimuli which, in turn, facilitates subsequent conceptual placement into those categories [Goss & Moylan, 1958, p. 191].

Most investigators interpret this finding as confirming the idea that verbal labels function as mediating or cue-producing responses (Klausmeier, et al., in press).

Dietze (1955) found that pre-schoolers who applied distinctive labels to similar nonsense shapes learned to name shapes faster than subjects who attached highly similar labels to the forms. Distinctive labels were also found to enhance generalization. It was Dietze's opinion that the labels functioned as verbal mediating or cue-producing responses.

Rather than viewing the facilitative effect of labels as being due to verbally mediating or cue-producing responses, an alternative (additional?) interpretation posits that the facilitating effect of labels is due to the subjects attending to those attributes that will be used in classification. That is, having subjects supply the same name to stimuli induces subjects to look for common attributes among stimuli, while different names induce subjects to look for attributes on which stimuli differ.

It follows that conceptual sorting will be facilitated by meaningful verbal labels although extensive pretraining with less meaningful labels has also been shown to be facilitative (Klausmeier, et al., in press).

In summary, the results of the previously described studies indicate that providing subjects with verbal pretraining influences conceptual sorting behavior. Specifically, labels facilitate generalizing and discriminating depending on whether or not the labels are familiar or unfamiliar. Furthermore, it has been shown that labels affect the learners' attentional response. The greater the meaningfulness of the label the easier it is for the learner to discern the attributes on which stimuli are alike or different. Thus, providing an individual with verbal labels seems to be a highly effective way of facilitating classification behavior.

3. Language and the Formal Level

The individual reaches conceptual maturity once he attains concept mastery at the formal level. The formal level represents the highest hierarchical level of concept attainment as posited by the CLD model.

Language is a necessary prerequisite for concept mastery at the formal level. It was previously noted that an individual may acquire labels at any of the three prior levels of concept attainment. At the formal level labels assume critical importance. The individual must be able to discriminate and label all of the defining attributes of a concept. Furthermore, an individual must infer the relevant attributes and be able to differentiate a concept in terms of its defining attributes (Klausmeier, et al., in press).

While language is of prime importance at the formal level, those who lack normal speech development (e.g., deaf children) may still attain con-

cept mastery. Speech per se is not a prerequisite for the attainment of concepts, though the individual must possess some additional means (e.g., sign language) for symbolizing and communicating the concept (Klausmeier, et al., in press).

Figure 1 presents the cognitive operations involved in attaining a concept at the formal level (see page 3). The prerequisite to the formal level of concept attainment is that of discriminating the defining and irrelevant attributes of a concept. Having discriminated and labeled the attributes, a learner may infer a concept in one of two alternative ways. One way involves incorporating the following three hypothesizing behaviors, (1) hypothesizing the relevant attributes and/or rules, (2) remembering hypotheses, and (3) evaluating hypotheses using positive and negative instances. The second available way of inferring a concept is through cognizing the common attributes and/or rules from only positive instances. The approach that a particular individual chooses depends upon the instructions he receives, his age, and the type of concept instances he experiences (Klausmeier, et al., in press).

Experimental evidence will now be presented relating language to the cognitive operations of the formal level.

Language and Discriminating Attributes

A necessary prerequisite to inferring a concept either by hypothesis testing or by cognizing the common attributes is discriminating and labeling the attributes of the stimulus objects. Discriminating and labeling the attributes serves two purposes, (1) to provide the necessary basis for ascertaining which attributes are to be considered relevant, and (2) to provide the underlying rule which relates the relevant attributes.

What is the effect of language on attribute discrimination? Rasmussen & Archer (1961) conducted a complex study to answer this question. The major purpose of the study was to determine what effect language pretraining had on concept formation when relevance of the labeled dimension and task complexity were varied.

The Rasmussen & Archer experiment required 128 adult subjects and five independent variables, (1) sex, (2) type of pretraining, (3) degree of pretraining, (4) amount of irrelevant information contained in the concept identification task, and (5) relevance of the labeled dimension. All subjects were assigned to either a language or aesthetic pretraining group receiving either a high or low degree of pretraining. Subjects assigned to the language pretraining received a paired-associate task in which they had to learn a different nonsense syllable to each of two nonsense stimulus shapes. Four stimulus dimensions (shape, color, size, and number) were varied in this task with shape being the relevant dimension. The remaining subjects were assigned to the aesthetic pretraining task. Subjects received the same stimulus forms presented in the same order as those subjects assigned to the language pretraining group. The stimuli were presented, as previously done, in a paired-associate manner. The subjects were asked to rate the stimuli on their degree of "pleasantness". By using such an approach, subjects in this group had just as much familiarity with the nonsense stimuli as did the language group, without having any particular dimension emphasized.

Upon completion of the pretraining experience, subjects were transferred to a concept identification task. Specifically, subjects were asked to sort the stimulus shapes into four categories. Two stimulus dimensions

were always relevant. When shape was relevant, color was irrelevant. When shape was irrelevant, size and color became the relevant dimensions.

The results were opposite to those expected, for the aesthetic pretraining led to better performance on the concept identification task than language pretraining. The investigators interpreted their findings as due to control subjects being induced to attend and discriminate among the several dimensions of the stimulus shapes, while subjects assigned to the language pretraining group were reinforced for ignoring the other dimensions and responding to the dimension of shape only. (It is highly possible that subjects assigned to the aesthetic pretraining condition supplied their own meaningful labels which facilitated performance more than the nonsense labels.) The interaction of pretraining and type of problem (shape relevant or irrelevant) was found to be significant. Subjects assigned to the language pretraining group (i.e., learned a nonsense label for the stimulus shapes) solved the concept identification task more efficiently when form was relevant than when form was irrelevant. The opposite was true of subjects assigned to aesthetic pretraining.

The findings of Rasmussen & Archer lends credence to the hypothesis that "providing subjects with verbal labels for attributes may make those attributes more salient or discriminable [Klausmeier, et al., in press]."

A recent complex study conducted by Deno, Jenkins & Marsey (1971) supports the notion that labeling of attributes facilitates discrimination and influences performance on subsequent concept learning tasks. Deno, et al., conducted the experiment to determine the effects of "both content-specific and content non-specific transfer variables in initial concept learning and subsequent learning from prose [p. 365]."

One hundred thirty-two college sophomores were assigned to 11 different treatments and control groups. The subjects were required to learn concepts relating to the characteristics of an electrocardiagram (EKG). Training consisted of seven sequential stages with appropriate control groups included for each stage. (For reasons of design complexity, only the training sequence of group one is presented. The remaining groups are based upon the training sequence here described.)

Prior to receiving the pretraining, subjects were taught a conservative focusing strategy for identifying concepts and to classify geometric forms of the Bruner-type (stages one and two). The third stage was the attribute-labeling stage, with subjects being taught to identify and label elements of a normal EKG. Stage four required that subjects learn to classify schematic drawings of an EKG into three classes, ischaemia, infarction, and injury. At this point, the group was divided into two subgroups, one group learned to classify inductively, the other group deductively. Stage five was a transfer task. Subjects were shown 30 photocopies of EKG tracings in a reception paradigm and asked to classify the tracings. A study session constituted the sixth stage. Subjects were given a two-page prose passage describing the three types of EKGs previously learned, some relations among the concepts, and several implications of the concepts for medicine. The last stage consisted of a multiple-choice test on the content of the prose passage.

The results were that, as expected, subjects who received training on attribute identification and labeling performed significantly better on the transfer measure than subjects who did not receive such training. Furthermore, subjects who had the opportunity to learn the attributes of a

concept prior to classifying schematic instances performed better on the prose test than subjects who did not receive prior training. This finding is consistent with the previously reported results. Analysis of the results led Deno and his co-workers to conclude that "prior training on the elements (learning to identify and label attributes) of a subject matter concept is a potent variable influencing subsequent performance on transfer tasks involving those concepts [p. 369]."

The results of the Rasmussen & Archer (1961) and the Deno, et al., studies lead one to the conclusion that the labeling of attributes facilitates attribute discrimination and consequently concept learning.

Language and Hypothesizing Behavior

At the formal level of concept attainment the individual is continuously involved in generating, remembering, and evaluating hypotheses. Each of these behaviors is a highly complex and interrelated operation (Klausmeier, et al., in press).

If an individual chooses the hypothesis-testing approach to inferring a concept, the individual must guess the possible defining attribute or combination of attributes. He then must verify his guess against instances and noninstances of the concept to determine the validity of his guess. If it is determined that his initial guess does not agree with the instances provided he must make another guess and evaluate it against other examples and nonexamples. Eventually the individual is able to combine all of the information he has received from hypothesis-testing and is able to correctly infer all the defining attributes and therefore the concept itself (Klausmeier, et al., in press).

What effect, if any, does language have on the hypothesizing behavior of the individual? Indirectly an answer to this question is furnished by Osler & Trautman (1961). Osler & Trautman conducted their experiment "as means for testing the inferred relationship between intelligence and the specific learning mechanism involved in concept attainment [p. 9]." Specifically, these investigators sought to ascertain if subjects of superior intelligence (mean IQ 119.7) attain concepts by testing hypotheses while subjects of normal intelligence (mean IQ 101.3) attain concepts through simple S-R associative learning. Osler & Trautman predicted that because the concept task being studied (the number two) contained a large number of irrelevant stimulus dimensions that children of superior intelligence (and presumably high verbal ability) would not perform as well as children of normal intelligence. On two measures of performance, the prediction was upheld.

A feasible interpretation of the Osler & Trautman findings is that subjects of superior intellectual ability were plagued by the large number of irrelevant stimulus attributes and therefore spent considerable time generating and evaluating hypotheses related to these irrelevant attributes. On the other hand, subjects of normal intelligence approached the problem on a simple associative level (similar to cognizing the common attributes) and therefore were able to exhibit better performance.

The hypothesis-testing process involves a great many cognitive skills and is not an effective way of inferring a concept unless the learner is proficient at generating, remembering, and evaluating hypotheses. An alternative approach is that of cognizing the common attributes from positive instances which involves less of a demand upon the logical reasoning capa-

city of the learner than remembering and evaluating hypotheses does (Klausmeier, et al., in press).

The relationship between language and the cognizing of common attributes is unclear. Klausmeier, et al., (in press) is in agreement with Amster (1965) who postulates that such an approach to inferring a concept (i.e., cognizing the common attributes) requires fewer verbal processes due to less complex reasoning.

While the relationship of language to the cognizing of common attributes is in need of further articulation, language is the vital medium for the operations of generating, remembering, and evaluating hypotheses.

Language and Stating the Concept Definition

According to the CLD model, concept attainment at the formal level requires that an individual provide the name of the concept and also name its societally accepted defining attributes (Klausmeier, et al., in press). This necessitates that the individual be able to communicate such information. Johnson & O'Reilly (1964) write, "a student who has learned a concept thoroughly can describe its common properties, use it in communication and solving problems, and define it. [p. 71]." It has been shown that subjects who have learned to classify correctly often cannot define correctly (Smoke, 1932). In terms of the CLD model these individuals have attained a concept at the classificatory level.

Johnson & O'Reilly are of the opinion that individuals who are able to correctly classify, yet unable to offer an acceptable definition of a concept can overcome this deficiency by verbally defining concepts.

Sixty, 11-12 year old children participated in a concept identification task. All subjects were randomly assigned to one of three experimental

groups; a verbal, pictorial, or pictorial-definition group. The stimulus materials consisted of 27, 4 x 5 inch cards with simple drawings of birds, and 27, 4 x 5 inch cards with verbal phrases describing the birds. The drawings differed on three attributes--wing color, tail color, and beak conformation. The picture cards also contained irrelevant phrases. The subjects were told that they were to learn the difference between a "gunkle bird" and a "bunkle bird" and that the difference consisted of a single thing rather than a combination of things. As each subject guessed, he was informed as to whether or not he was correct. Classification training continued until a criterion of 10 consecutive correct responses was reached. After learning to classify, the subjects were asked, "How do you think you can tell a gunkle bird from a bunkle bird?" Subjects did not receive an evaluation of their answer.

Upon completing classification training, subjects received a transfer task requiring 10 correct classifications. The pictorial group received the cards with the drawings of the birds to classify, then the defining task and lastly a transfer task consisting of the verbal phrase cards. A second group (verbal) received the verbal phrase cards to classify, then the defining task, and lastly the transfer task consisting of cards containing the drawings of birds. The third group of subjects received the colored pictures to classify but after each five cards these subjects were asked to guess how to tell a gunkle bird from a bunkle bird. Subjects did not receive any feedback regarding their responses. The transfer task for the third group consisted of the cards with the verbal phrases.

The definitions given by the children were rated on a scale from 0-4 by three graduate assistants. The results revealed that subjects who re-

ceived practice in defining (pictorial-definition group) gave almost twice as many acceptable definitions as those subjects who were not provided with practice (pictorial group). Johnson & O'Reilly conclude that even "a small amount of practice in defining, even without knowledge of results improves defining performance [p. 73]." Once again the facilitative effect of language on concept attainment is evidenced.

This completes the examination of the role of language and its relationship to concept attainment as posited by the CLD model. Empirical evidence was presented which showed that language is a powerful medium for influencing concept attainment. At each of the four successive levels of attainment, language was shown to play a facilitative role. Specifically, at the lower three levels of attainment, labels were found to influence the operations of attending, discriminating, remembering, and generalizing. At the formal level, where language is a requisite, language was shown to greatly influence the operations of discriminating the attributes and the necessary hypothesizing behaviors. Therefore, it would seem logical to conclude that language and concept attainment are interrelated.

Verbal Labels and Concept Learning by Retardates

It has been previously established that language and conceptual learning and development are intricately interwoven. It now seems feasible to examine the psychological literature investigating the relationship between verbal labels and the performance of educable retardates on various conceptual tasks.

The experimenter hypothesizes that verbal competency plays a very important role in the child's ability to handle concepts. This is especially so with the educable retardate. Many of the performance differences between normal and retarded children can be explained as being due to an impaired ability to use verbal symbols as a means of controlling behavior and of abstracting from experience.

Burt (1953) and Meyers, et al., (1961), in studying mentally retarded children became aware of their inability to manipulate and comprehend verbal symbols. Milgram & Furth (1963) are of the opinion that deficiency in verbal ability is of paramount importance, especially since a number of studies show support for a definite relationship to language in learning and problem solving situations.

Milgram & Furth (1963) conducted a study investigating the influence of language on concept attainment in educable mentally retarded and normal school age children. (The normal children were included as an MA control group.) The investigators hypothesized that

> the retarded child is seen as limited in the extent to which he can utilize his language experience in conceptual grasp of situations and problems. It is expected that the retarded children will do as well as MA controls on concept tasks in which language experience is irrelevant and will perform more poorly on tasks in which language experience is relevant [p. 734].

Using three different kinds of concept attainment tasks, each requiring varying degrees of verbal ability, Milgram & Furth confirmed their hypothesis. The educable mentally retarded subjects did not exhibit inferior performance when compared to normal controls on those tasks requiring greater perceptual ability than language ability, but performed more poorly when the task called for a verbal mode of solution.

Furth & Milgram (1965) describe an experiment (experiment I) in which both educable mentally retarded and normal children were compared on a classification task. The four conditions of the task were: (1) picture sorting, (2) picture verbalization, (3) word sorting, and (4) word verbalization. It was hypothesized that the addition of verbal factors to the task would increase task difficulty for both groups, but more so for the educable retarded subjects.

Subjects were randomly assigned to either the picture or word group. The subjects assigned to the picture sorting task viewed 18 sets of seven pictures, and were required to point to three pictures that went together. If an incorrect response was given, the experimenter pointed to the correct solution. Upon completion of the picture sorting task, subjects were shown the correct pairings from each of the previous sets and asked "in which way do these three go together." Subjects were not provided with any corrective feedback regarding their verbalizations. Children assigned to the word sorting task were tested in the same manner as children assigned to the picture sorting task. The only difference was that words were now the stimuli rather than pictures and the experimenter read aloud the cards as they were placed before the subject. During word verbalization, subjects were asked to name the concept when he heard and saw the three words of

each set.

The performance of the 38 retarded subjects (mean MA, 9.0) was compared to 38 normal third grade children (mean CA, 9.1). The results indicated that, as anticipated, the retarded and normal subjects compared favorably to the MA controls on the nonverbal (picture) task, but on the average, were poorer on the other three conditions. The retarded subjects exhibited their poorest performance on the word sorting task which had as its prerequisite the manipulation and decoding of verbal material. Furth & Milgram postulate that it would seem "reasonable to attribute the deficiency of the retarded to the difficulty connected with verbal understanding or with verbal expression [p. 328]."

Miller, Hale, & Stevenson (1968) examined learning and problem solving between adolescent normal and retarded children. The subjects were presented with 10 tasks; a paired-associate learning test, two kinds of discrimination learning, probability and incidental learning tests, a concept of probability measure, anagrams, conservation of volume indices, age estimation, and a verbal memory test. The entire procedure for each task was filmed and the subjects responded individually in booklets.

The results indicated that the retarded subjects performed less effectively than the normal subjects. This held true even though one group of normal subjects was matched with the retarded subjects on CA and a second group was matched on MA. As the tasks increased in verbal complexity, the differences between the matched MA groups became increasingly apparent. The only measure on which educable retarded subjects performed at a higher level than the normals was probability learning. The tasks which reflected the greatest disparity in performance were verbal memory

and anagrams.

It seems evident from the previously described studies that in certain situations retarded and normal subjects compare favorably on conceptual tasks requiring a low level of verbal ability, but as the verbal requirements of the task increase, so does the difference in performance.

The preceding studies also indicate that the educable retardate is not deficient in overall conceptual ability, but experiences difficulty when the learning situation required verbal competency. Studies have indicated though that meaningful verbal labels facilitate the performance of retardates on various conceptual tasks (Smith & Means, 1961; Stephens, 1966; and Landau, 1968).

Of vital interest to the present experiment are the studies of Stephens (1966) and Landau (1968). These studies have indicated that when educable retardates are supplied with appropriate verbal training through experimental manipulation they perform as well as or better than their normal peers on various concept learning tasks.

Stephens (1966) studied 30 educable mentally retarded and 60 normal children matched for CA and MA on a categorization task. The task involved having subjects identify three types of categories using various strategies. The categories consisted of perceptual categories (size, color, form), use categories (flying vs. non-flying objects), and human categories (age differences, sex differences). The stimulus materials included a series of 20 cards, six cards for each of the three categories and two sample cards. Each card contained seven pictures, four of which were representative of the category and three which were irrelevant to the category being tested.

Upon completion of the Goodenough Intelligence Test, subjects were instructed to mark each of the objects belonging together. Following this, the remaining 18 cards were presented in a predetermined random order. Subjects participated in both an unstructured and structured test situation. The unstructured test required that the subjects mark four items which were most alike or belong together. Subjects were not provided with a verbal cue as to the appropriate category to be employed, nor did they receive information as to the correctness or incorrectness of their response. Stephens also required the subjects to specify verbally the basis for selecting the items representing the category. The responses of the subjects were recorded. Next, the subjects received the structured test in which the 18 test cards were presented for the second time with the experimenter specifying the category involved for each card and the subjects locating members of that category.

Analysis of the unstructured test results indicated that the retardates did not differ from their MA controls on both perceptual and human categories, but both groups performed significantly poorer than the older CA controls. On the uses category, the MA controls performed significantly better than the educable retardates, with or without the label being supplied.

On the structured test, results revealed that when the experimenter provided the appropriate verbal label, all three groups attained scores which were significantly higher than their performance levels on the unstructured test. The only exception being the performance of the older normals on the perceptual category who exhibited a ceiling effect.

Blount (1968) writing about the Stephens (1966) study states, "evidently retardates can use verbal labels for concepts as well as normals when these labels are supplied [p. 284]."

Landau (1968) compared the performance of 60 male educable retardates, 77 normal lower class boys, and 50 normal upper class boys on Dunn's Object Sorting task. All subjects were matched on CA (younger and older), and on MA (low and high). Performance measures indicated no difference between normal lower class boys and educable retardates (matched for MA) on any of the four variables measured. Furthermore, the results indicated that the educable mentally retarded boys performed "as well as or better than normal subjects when the retardates are given the additional benefit of (verbal) cues [p. 94]."

A study of related interest to the present experiment is a 1966 study by Prehm. Prehm investigated "whether verbal pretraining would affect performance on a concept acquisition task, and whether the effects of pretraining would generalize to a concept acquisition task on which subjects have not received pretraining [pp. 599-600]." Prehm's subjects consisted of 27 "low risk" (IQ > 84) and 27 "high risk" (IQ < 83) children randomly chosen from a high risk population. That is, culturally disadvantaged children, who, at some point in their school career, have a high potential of being defined as educable mentally retarded. The groups did not differ significantly from one another in terms of MA and CA, but did differ significantly in terms of IQ.

Nine subjects within each risk group were randomly assigned to three pretraining groups: verbal label, attention, and control. The stimulus materials used in the pretraining task consisted of two sets of 16 cards.

Subjects were randomly assigned to receive pretraining on either set one or set two of the stimuli used for transfer task I. Subjects did not receive pretraining on transfer task II. Subjects in the verbal label group were given the names of the cards and were instructed to sort them into two piles, saying the name of each card as it was placed on the appropriate pile. The attention group subjects sorted the cards into two piles based upon the relevant stimulus dimension. These subjects were neither told nor encouraged to name the stimulus cards. The control group sorted the cards in an unsystematic fashion. All subjects sorted the cards three times with the experimenter shuffling the cards between each sort. Upon completion of the pretraining task, subjects received the experimental task. Subsequent to obtaining criterion (selection of the positive instance of a concept 12 times in succession) on transfer task I, each subject was immediately presented with transfer task II.

The results of Prehm's research revealed no significant IQ differences between risk groups, but significant training effects were found, such that the subjects assigned to the verbal label condition obtained the concept in significantly fewer trials than subjects assigned to either the attention or control group.

The preceding studies of Stephens (1966), Prehm (1966), and Landau (1968) indicate that there

> is more than sufficient evidence for the conclusion that when attention is focused on the relevant variables or at least when the situation is set up so that the subject will be more likely to discover the relevant variables via pretraining or whatever, the retardate does as well as or better than his MA control. The evidence further indicates that appropriate verbal pretraining should result in faster original learning, greater generality, and an enhanced ability to verbalize solutions [Blount, 1968, p. 292].

Summary

Upon establishing that Heber's (1961a) definition of mental retardation is the most appropriate, research evidence was presented which related language and the conceptual learning and development model. It was determined that language was vitally important to the operations involved in attaining a concept at each of the four attainment levels. As the learner progresses from one level to the next hierarchical level, verbal competency assumes an increasingly larger role.

The concluding section of this chapter presented empirical evidence establishing the relationship between verbal labels and the performance of educable retardates on various types of conceptual tasks. It was ascertained that the educable mentally retarded child does not perform as well as his normal peers on those tasks requiring verbal competency (Milgram & Furth, 1963; Furth & Milgram, 1965; and Miller, et al., 1968). Yet, when through experimental manipulation verbal pretraining was provided, the educable retardate performed as well as or better than normal subjects matched on MA (Stephens, 1966; and Landau, 1968). Furthermore, the work of Prehm (1966) would tend to indicate that subjects who received verbal labels with appropriate instruction would perform better than either subjects who received labels only or the control subjects.

Chapter III

EXPERIMENTAL METHOD

The purpose of the present study was to investigate the effects of verbal labels alone and also the combined effects of two kinds of instructions and verbal labels on the concept attainment of educable mentally retarded and normal male subjects of the same mental age. The concept to be examined was that of equilateral triangle.

The specific questions which the experiment sought to answer were:

1. What is the effect of normal vs. retarded mental development on concept attainment?

2. What is the effect of higher vs. lower mental age on concept attainment?

3. What is the effect of various kinds of instruction on concept attainment?

4. Is there an interaction between level of mental age and normal vs. retarded mental development?

5. Is there an interaction between kinds of instruction and normal vs. retarded mental development?

6. Is there an interaction between kinds of instruction and higher vs. lower mental age?

7. Is there an interaction among kinds of instruction, normal vs. retarded mental development, and higher vs. lower mental age?

Based upon the preceding questions the following directional hypotheses are offered for each of the three main effects questions.

1. There will be no difference between normally developing and mentally retarded boys on concept attainment.

2. Higher MA boys will perform significantly better than lower MA boys on concept attainment.

3. The rank order of the treatments from lowest to highest will be control, verbal labels only, verbal labels pertaining to pentagon with instruction, and verbal labels pertaining to equilateral triangle with instruction; also the last two treatments will result in significantly higher concept attainment than the control condition.

No hypotheses are entertained for questions 4-7.

The following sections describe the method by which the preceding questions and hypotheses were given experimental test. A pilot study was conducted to assure that lessons and other experimental procedures functioned properly.

Pilot Study

Subjects

Thirty-two subjects were included in the pilot study, 16 first grade boys and 16 primary educable mentally retarded boys. The subjects were chosen from schools within the Janesville (Wisconsin) Public School system. The mean CA of the first grade subjects was 7.0 years. The mean CA of the EMR subjects was 9.6 years. The mean MA of the first grade subjects, as determined by the Kuhlman-Anderson Measure of Academic Potential (Kuhlman

& Anderson, 1963), was 6.6 years. Using the same measuring instrument, the mean MA of the EMR subjects was determined to be 6.4 years.

Subjects were not included in the experiment if they manifested substantial motor handicap, visual or hearing difficulty, outstanding emotional disturbance, or gross language disability.

Instructional Materials

To study the effect of verbal labels alone and also the combined effects of two kinds of instruction and verbal labels on the concept attainment of educable mentally retarded and normally developing boys of the same mental age, four lessons were constructed that presented selected labels and instruction on the labels. The verbal labels were chosen from a battery of Center developed tests on the equilateral triangle (Klausmeier, Ingison, Sipple, & Katzenmeyer, 1972). Selection was based upon the importance of the labels for the attainment of the concept being taught in the lessons and tested in the battery. One lesson was developed for each of the experimental treatment conditions. Each lesson took approximately 15 minutes to complete and was divided into segments of 3 1/2 - 4 minutes, 4 minutes, 3 minutes, and 3-4 minutes. The lesson content was reviewed by R & D Center math curriculum experts to assure accuracy. The lessons were designed to encourage student participation.

Briefly, treatment I was a lesson on pentagons. The lesson included giving 12 verbal labels plus instruction on the labels. Treatment I contained nine labels common to the defining attributes of both equilateral triangles and pentagons plus three labels specific to pentagons.

Treatment II was very similar in content to treatment I. The second experimental treatment was a lesson on equilateral triangle using the nine attribute labels of treatment I plus three labels specific to equilateral triangles. As in the previous treatment, instruction on the labels was provided.

Treatment III, in which subjects received only verbal labels, contained the nine labels found in both treatments I and II plus the specific labels from each treatment condition. Subjects in this condition therefore received 15 labels.

The subjects assigned to the control group, treatment IV, received verbal labels on cutting tool with instructions on the labels. Fifteen verbal labels were to be found in this condition, nine labels common to the defining attributes of cutting tool plus six labels of specific kinds of cutting tools.

A complete copy of the lessons used in the pilot study can be found in Appendix A. Table 1 provides a listing of the labels used in each lesson.

The stimuli (verbal labels) used in the lessons were photographically set on a Stripprinter and placed on 3 x 5 inch file cards with felt attached to one side of the card. Each letter was 1/4 inch high. A large (24 x 36 inch) black flannel board manufactured by the Instructo Corporation was used for presentation purposes.

The drawings of cutting tools and the non-examples used in treatment IV were drawn by an artist. All drawings were 5 inches in length and were mounted on 4 x 6 inch file cards with felt attached to one side of the cards.

Table 1

Listing of Verbal Labels Used in Each Lesson

Treatment I	Treatment II
Verbal labels + instruction on pentagon labels	Verbal labels + instruction on equilateral triangle labels
polygons	polygons
pentagon	triangle
regular pentagon	equilateral triangle
five	three
sides	sides
angle	angle
equal	equal
shape	shape
perimeter	perimeter
closed figure	closed figure
open figure	open figure
simple figures	simple figures

Treatment III	Treatment IV
Verbal labels only	Verbal labels + instruction on cutting tool labels
polygons	tools
pentagon	cutting tools
regular pentagon	hard
five	sharp
triangle	dull
equilateral triangle	blade
three	teeth
sides	tooth-edge
angle	smooth-edge
equal	scissors
shape	pen knife
perimeter	axe
closed figure	rip saw
open figure	hack saw
simple figures	two-man saw

The line drawings of the open and closed figures used in treatment I and treatment II (pentagon and equilateral triangle, respectively) were also drawn by an artist. Each side of the open and closed pentagon drawings were 1 1/2 inches in length. The drawings were mounted on 4 x 6 inch file cards with felt attached to one side. Each side of the open and closed equilateral triangle drawings was 2 inches in length. The drawings were mounted on 3 x 5 inch file cards which had felt attached to one side. Copies of the drawings of cutting tools, the non-examples, and the open and closed figures are provided in Appendix B.

Felt cut-outs were also incorporated in the teaching of verbal labels both in treatment I and treatment II. Three cut-outs in the shape of a regular pentagon were used in treatment I. The cut-outs were of different colors and sizes, the largest being red with each side 3 13/16 inches long. A green cut-out with each side 2 9/16 inches long and a yellow cut-out with each side 1 11/32 inches were also used to explain the various attributes of the regular pentagon.

Three cut-outs in the shape of an equilateral triangle were used in treatment II. As with the cut-outs used in treatment I, the cut-outs were of different sizes and colors. The colors were the same as used in the lesson on pentagons. The size of the equilateral triangle shapes were equated such that the areas of the three pentagon cut-outs were the same as the areas of the equilateral triangle cut-outs. The sides of the largest cut-out were six inches, the sides of the remaining two cut-outs were four inches and two inches, respectively.

Dependent Measure

The dependent measure used in the pilot study was a subtest of the Equilateral Triangle Test Battery. The subtest chosen was the vocabulary test, test ID. Subjects received this test as a pretest-posttest measure. A score was obtained based upon the total number of correct responses (13 possible correct responses). An item was scored as being either correct or incorrect.

A copy of the test is to be found in Appendix C.

Procedure

Subjects were tested on the Kuhlman-Anderson Measure of Academic Potential (form A) seven school days prior to the initiation of the experimental treatments. Said testing required approximately 70 minutes to complete. Subjects were tested in an empty room within each of the selected schools. The normal subjects received the measure in groups of eight, while the EMR subjects were tested in groups of five. Each subject sat at a desk appropriate for his height.

The experimenter was able to test two groups of subjects a day. In order to obtain the necessary number of subjects, the experimenter tested three groups of first grade boys for a total of 24 boys. A day and a half was required for the testing of the normal subjects. Upon completing the testing of the normal subjects, the experimenter was unable to continue full day testing and was able to test only in the afternoon. The experimenter tested 25 EMR subjects. Testing of the retarded boys therefore required five afternoons.

The experimenter randomly chose 16 of the 24 tested normal subjects whose MA was between 5.0 and 7.5 years. The experimenter then selected

16 primary EMR boys so as to approximate the mean MA of the selected first grade boys.

On the day the subjects were to receive the experimental treatments, the experimenter and an assistant went to the subjects' classroom and escorted the subjects to the testing room. The subjects were informed that the experimenter was interested in studying how children learn and that they could help by answering some questions. The experimenter then left the room and the assistant distributed a pencil and a pre-named test to each subject. The test was used as a pretest measure of the subjects' knowledge of selected geometric concepts. Approximately 20 minutes were required to complete the pretest as each question was read to the subjects twice. Upon completion of the pretest, the assistant left the testing room and the experimenter returned. The experimenter then presented one of four 15 minute lessons depending upon which treatment the subjects were assigned to. The order of presentation of the treatments was randomized.

The subjects assigned to treatment I received an instructional lesson on the 12 labels for pentagon. Subjects in treatment II received a fifteen minute lesson on the 12 labels for equilateral triangle. Treatment group III received verbal labels relevant to both pentagon and equilateral triangle -- without receiving instruction on either the pentagon or the equilateral triangle. Treatment IV, which served as the control group, received a placebo lesson to equate the time that the experimenter spent with the other treatment groups. Subjects in this condition received instruction and verbal labels relevant to cutting tools.

Each lesson concluded with the assistant administering test ID of the battery once again as a posttest measure. The assistant was unaware which

lesson the subjects received. The subjects received a posttest in order to assess the effect of the various lessons. The same procedures used in administering the pretest were followed in the administration of the posttest. Upon completion of the posttest, subjects were returned to their classrooms by the experimenter or his assistant. Approximately one hour was required for each administration in groups of four. Being unable to always devote a full day to testing, five days were necessary in order to complete testing.

Experimental Design

The design of the pilot study, being consistent with its purpose, incorporated four independent variables which were the four types of treatments with a stratifying variable of being either normal or mentally retarded. The dependent variable was a gain score, (pretest vs. posttest score). Performance assessed was the total number of items correct on test ID of the equilateral triangle battery.

Subjects within each classification (normal or mentally retarded) were ranked by their test scores, i.e., MA, blocked into groups of four, and randomly assigned to one of the four treatment conditions, such that one subject from each block of four subjects was assigned to each experimental treatment. Therefore, there were four subjects per cell for a total of 16 subjects per classification.

Due to difficulty in obtaining a sufficient number of subjects, the experimenter was forced to select EMR subjects from three different schools. This therefore necessitated randomly assigning schools to treatments for the EMR subjects. Table 2 illustrates the design of the pilot study.

Table 2

Design of Pilot Study

Normal Male Subjects

	Verbal Labels with Instruction on Pentagon Labels	Verbal Labels with Instruction on Equil. Triangle Labels	Verbal Labels with No Instruction on the Labels	Verbal Labels with Instruction on Cutting Tool Labels
Pretest				
Posttest				

Educable Mentally Retarded Subjects

	Verbal Labels with Instruction on Pentagon Labels	Verbal Labels with Instruction on Equil. Triangle Labels	Verbal Labels with No Instruction on the Labels	Verbal Labels with Instruction on Cutting Tool Labels
Pretest				
Posttest				

Results

Being consistent with the purpose of the pilot study, i.e., to assure that lessons and other experimental procedures function properly with a target sample of subjects, a descriptive analysis using a non-inferential comparison of means was applied to the data. Table 3 presents the results of the descriptive analysis.

Beyond the finding that the ordering of the treatment means and the gain scores were in the predicted direction, the purpose of the pilot study was also accomplished. Specifically, the experimenter was able to ascertain more fully the time required for each of the instructional lessons, and that the material presented in the lessons had the desired effects. Furthermore, the experimenter was able to gain experience in both administering the Kuhlman-Anderson test and in working with first grade and primary EMR boys in an experimental situation.

Table 3

Mean Number of Correct Responses on the Vocabulary Subtest of the Equilateral Triangle Test Battery (Pilot Study)

		Treatment Condition								
		I	N	II	N	III	N	IV	N	$\bar{X}$ Totals
Normals	Pretest	3.00 (2.44)	4	2.75 (2.50)	4	1.75 (.957)	4	1.25 (1.50)	4	2.18 (1.90)
	Posttest	4.50 (3.41)	4	6.00 (2.16)	4	3.75 (1.89)	4	2.00 (2.16)	4	4.06 (2.67)
	Gain Score	1.50		3.25		2.00		.75		1.88
EMR	Pretest	2.25 (.957)	4	2.25 (2.21)	4	1.50 (1.91)	4	6.25 (1.89)	4	3.06 (2.51)
	Posttest	4.00 (.816)	4	4.75 (.957)	4	3.00 (3.55)	4	1.25 (.957)	4	3.25 (2.20)
	Gain Score	1.75		2.50		1.50		-5.00		.19

Note. – Standard deviations are given in parentheses.

Main Study

Subjects

One hundred sixty subjects, 80 educable mentally retarded boys and 80 normal boys participated in the main study. Within each classification there were 40 low MA boys and 40 high MA boys. Low MA corresponded to an MA range of 5.0 - 7.5 years, high MA corresponded to an MA range of 7.6 - 10.0 years. The subjects were chosen from various schools within the Milwaukee Public School system.

The design called for subjects to be drawn from a large school typical of the inner city of Milwaukee. Due to a lack of EMR subjects, the experimenter had to select boys from five other schools in order to obtain the required number of EMR subjects. Examination of school records indicated that three of the schools were participating Title I schools, and that five of the six schools, including the school from which the normal subjects were chosen were below both national and city norms on the Iowa Test of Basic Skills. Furthermore, all six schools have a higher percentage of pupil mobility than other city schools. Lastly, four of the selected schools have a higher percentage of pupils above age in each grade level than other schools in the Milwaukee School system. Three of the participating schools are representative of the inner city schools of Milwaukee while the remaining schools are representative of non-inner city schools (D. Rowe, personal communication, March 4, 1974). The three inner city schools include the school from which the normal subjects were drawn and those schools from which the majority of EMR subjects were chosen.

The normal subjects were selected from first and third grade classrooms within one of the six schools from which the EMR subjects were drawn.

The mean CA of the first grade subjects was 7.1 years, the mean CA of the third graders was 9.0 years. The EMR subjects were chosen from both primary and intermediate special education classrooms. Approximately half of the EMR subjects were drawn from the same school as the normal subjects. The mean CA of the primary subjects was 10.1 years while the intermediate EMR subjects had a mean CA of 11.6 years. The Kuhlman-Anderson Measure of Academic Potential was used to determine the MA of the subjects. Using form A for both the first grade subjects and primary EMR subjects, it was determined that the mean MA of the first grade subjects was 6.2 years. The primary EMR subjects were found to have a mean MA of 6.3 years. Form B was used for both the third grade subjects and the intermediate EMR subjects. The mean MA of the third grade subjects was determined to be 8.5 years. The mean MA of the intermediate EMR subjects was found to be 8.3 years. Intelligence quotients were available from tables provided in each test manual. Examination of the tables indicated that the mean IQ of the first and third grade subjects were 88.9 and 95.3, respectively. The mean IQ of the primary educable retardates was found to be 75.0, while the intermediate EMR subjects had a mean IQ of 81.7. The IQs of some of the primary and intermediate EMR boys were extrapolated. That is, for those subjects whose CA was higher than provided for in the test manuals it was necessary to disregard the true CA and use the CA provided for in the test manuals. Table 4 presents the preceding information in a table format.

Subjects were not included in the study if they manifested substantial motor handicap, visual or hearing difficulty, outstanding emotional disturbance, or gross language disability.

Table 4

Mean MA, CA, and IQ of Normal and Educable Mentally Retarded Subjects of Low and High MA

		N	MA		CA		IQ	
			$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.
Normal	Low	40	6.21	.447	7.06	.611	88.20	6.93
	High	40	8.53	.752	8.95	.700	95.38	11.37
EMR	Low	40	6.26	.542	10.08	1.41	75.03*	8.27
	High	40	8.33	.488	11.61	.854	81.73*	7.39

*Extrapolation from IQ tables of Kuhlman-Anderson Test Manuals.

Instructional Materials

The stimulus materials, i.e., the verbal labels, felt cut-outs, and various drawings, used in the pilot study were also used in the main experiment. Modification of the stimulus materials was not necessary.

However, minor modifications were required of the lessons. Based upon the pilot study, it was determined that each lesson required approximately 16 minutes for completion rather than the anticipated 15 minutes. The lessons were divided into segments of 5 minutes, 4 minutes, 3 minutes, and 4 minutes. It was further determined that the concluding activity of the fourth lesson (placebo) required a greater amount of time than was anticipated and therefore fewer stimulus arrays were presented to the subjects. Also, since the main study did not incorporate a pretest vs. posttest design, the section pertaining to the administration of the pretest was deleted from the lessons. Additional modifications of the lessons were not required. (A complete copy of the four lessons used in the main study can be found in Appendix D. The stimulus materials were previously described in the beginning of this chapter.)

Dependent Measure

The assessment measure used in the main study was a battery of tests on equilateral triangle developed at the Wisconsin Research and Development Center for Cognitive Learning (Klausmeier, et al., 1972). The tests measure performance related to distinct levels of conceptual development. Performance assessed was the total number of items correct on the levels (concrete, identity, classificatory, and formal [discriminating attributes + vocabulary]) subtests of the Equilateral Triangle Test Battery. Responses

were scored as being either correct or incorrect.

A total of 29 items are found on the levels subtests (eight each on concrete and identity, three each on classificatory and discriminating attributes, and seven on vocabulary). Table 5 presents the Hoyt reliability coefficients for the test items according to levels and uses. The reliability coefficients are given for all 160 subjects and for the 80 normal subjects and 80 educable mentally retarded subjects. (As stated in Chapter I, performance on the uses subtests was not analyzed due to the low reliability of the measures.)

A copy of the assessment battery is to be found in Appendix E.

Procedure

Subjects received the Kuhlman-Anderson Measure of Academic Potential appropriate for their mental age level approximately two weeks prior to the initiation of the experimental treatments. Subjects were given the Kuhlman-Anderson so that the experimenter could adequately ascertain their current mental age.

First grade subjects and primary EMR subjects received form A, while third grade subjects and intermediate EMR subjects were tested on the nonverbal third grade form, form B. Approximately 70 minutes were required for each testing session regardless of the test form. Subjects were tested in either empty classrooms or conference rooms within each of the selected schools. The first grade subjects and third grade subjects were tested in groups of ten. Both the primary and intermediate EMR subjects were tested in groups of six. Each subject sat at a desk appropriate for his height.

Table 5

Hoyt Reliability Coefficients for the Subtests of the Equilateral Triangle Test Battery

Subtest	Total Subjects (N = 160)	Normal (N = 80)	EMR (N = 80)
Levels:			
Concrete	.8239 (.4372)	.8036 (.3702)	.8336 (.4932)
Identity	.7217 (.4957)	.7875 (.4070)	.6693 (.5677)
Classificatory	.6543 (.3916)	.5500 (.4439)	.7573 (.3295)
Formal	.2601 (1.4312)	.2734 (1.4224)	.2535 (1.4404)
Discrim. Attributes	.5971 (.5724)	.5946 (.5730)	.6028 (.5726)
Vocabulary	.2058 (1.1578)	.1942 (1.1511)	.2199 (1.1635)
Total Levels	.6633 (1.7679)	.6460 (1.7214)	.6817 (1.8064)
Uses:			
Problem Solving	.1745 (.8674)	.0494 (.8968)	.2763 (.8344)
Supraordinate-Subordinate	.1602 (1.2179)	.2823 (1.2044)	.0080 (1.2335)
Total Uses	.3310 (1.5476)	.3251 (1.5605)	.3399 (1.5346)

Note. - Standard error of measurements are given in parentheses.

The experimenter was able to test three groups of subjects a day. A second experimenter, who was thoroughly familiar with the administration of the Kuhlman-Anderson, was available to assist the experimenter on a part-time basis. In order to obtain the necessary number of subjects, the experimenter and his assistant required four days to complete the testing of the first and third grade subjects. A total of five testing days (full days and half days) were required for obtaining the required number of EMR subjects. (For various reasons a full day of testing was not always possible.) Therefore, a total of nine days was required for the administration of the Kuhlman-Anderson.

The experimenter randomly chose 40 primary EMR subjects from a group of retardates whose MA was between 5.0 and 7.5 years. The experimenter ascertained the mean MA of these subjects and then selected 40 first grade subjects so as to have an equivalent mean MA. The selection was accomplished from a group of first graders whose MA was between 5.0 and 7.5 years. The experimenter followed the same procedure for selecting the high MA normal and EMR subjects. The experimenter randomly chose 40 intermediate EMR subjects from a group of retardates whose MA was between 7.6 and 10.0 years. The experimenter determined the mean MA of the subjects and then selected 40 third grade subjects so as to have an equivalent mean MA. As before, the selection was accomplished through repeated random sampling, i.e., from a group of third graders whose MA was also between 7.6 and 10.0 years.

Subjects received the treatments in groups of five whenever possible. Due to absences and having EMR subjects from six different schools, treatments were administered on occasion to individual subjects or in groups of

two, three, or four. The order of presentation of the treatments was randomized. The experimenter administered the lesson and dependent measure to half of the subjects in each cell. The experimenter administered the lesson to the remaining five subjects of each cell with the assistant administering the dependent measure. The assistant was not aware of which lesson the subjects received. During randomly selected treatments, the assistant was present to record the attention level (time-on-task) of the subjects. A copy of the attention measure is to be found in Appendix F.

On the day the subjects were to receive the treatments, the experimenter and his assistant went to the subjects' classrooms and escorted the subjects to the testing room. The subjects were informed that the experimenter was interested in studying how children learn and that they could help by answering some questions, but first the experimenter wanted to talk to them about something very interesting.

The subjects assigned to treatment I received an instructional lesson on the attributes of a pentagon. The subjects were also supplied with verbal labels relevant to the attributes of a pentagon. The subjects in treatment group II received a 16 minute lesson as to the attributes of an equilateral triangle. This treatment group also received verbal labels relevant to the attributes of an equilateral triangle. Treatment group III received verbal labels relevant to the attributes of a pentagon and equilateral triangle -- without receiving instruction on either the pentagon or the equilateral triangle. Treatment group IV, which served as the control group, received a placebo lesson to equate the time that the experimenter spent with the other treatment groups. Subjects in this condition received instruction and verbal labels relevant to cutting tools.

Each lesson concluded with the subjects receiving the Equilateral Triangle Test Battery. The subjects received this instrument in order to ascertain the effect of the various lessons on their level of concept attainment. The measure was administered in accordance with procedures outlined in the administrator's manual. Upon completion of the battery, the subjects were returned to their classrooms by the experimenter or his assistant.

Approximately one hour was required for each administration of the treatments. A total of 12 days (both full days and half days) was required to complete the administration of the treatments to all of the subjects.

Upon completion of the study, all teachers whose students participated in the experiment received an evaluation form on which they were to indicate whether or not their students had received instruction on the labels presented in the lessons. A copy of the evaluation form comprises Appendix G.

Experimental Design

The design of this experiment consisted of a 2 x 2 x 4 completely crossed design with fixed effects. The four treatment conditions were the independent variables, with mental age (high or low) and classification (mentally retarded or normal) included as stratifying variables. The total number of correct responses on the levels subtests of the Equilateral Triangle Test Battery constituted the dependent measure. The 2 x 2 x 4 design is illustrated in Table 6.

Within each classification, there were 80 subjects, 40 high MA subjects and 40 low MA subjects. Therefore, a total of 160 subjects were involved in the experiment. Subjects within each mental age level of each classi-

Table 6

Design of Main Study

Normal Male Subjects

	Verbal Labels with Instruction on Pentagon Labels	Verbal Labels with Instruction on Equil. Triangle Labels	Verbal Labels with No Instruction on the Labels	Verbal Labels with Instruction on Cutting Tool Labels
Low MA				
High MA				

Educable Mentally Retarded Subjects

	Verbal Labels with Instruction on Pentagon Labels	Verbal Labels with Instruction on Equil. Triangle Labels	Verbal Labels with No Instruction on the Labels	Verbal Labels with Instruction on Cutting Tool Labels
Low MA				
High MA				

fication were randomly assigned to one of four treatments such that there were 10 subjects per cell.

The analysis of the data consisted of five analyses of variance using the NWAY I computer program (STATJOB statistical series). The analyses were conducted according to levels in order to determine the main effects due to treatment, mental age, and normal vs. retarded mental development, along with any of the possible interactions. In post hoc analyses, Tukey's (1949) test was applied in making all appropriate pairwise comparisons.

Chapter IV

RESULTS

The results of the present experiment are reported in terms of performance on the levels subtests of the Equilateral Triangle Test Battery. The performance of the subjects was analyzed according to the questions stated at the outset of the experiment and in Chapter III.

The results of the subject attention measure and the teacher evaluation form of classroom instruction are also presented in this chapter.

Performance on the Concrete Level

The mean number of correct responses on the concrete level subtest according to mental classification (normal or educable mentally retarded) and mental age (low or high) is shown in Table 7. (The number of correct responses for each individual subject can be located in Appendix H.) It is noted that the normal subjects had a mean score higher than the EMR subjects (7.75 vs. 7.51), and that the high MA subjects had a mean score higher than the low MA subjects (7.81 vs. 7.45, respectively).

The effect of the various treatments was analyzed according to mental classification and mental age. Table 8 illustrates the mean scores of both normal and EMR subjects according to treatments while Table 9 illustrates the mean scores of low and high MA subjects with respect to treatments.

An analysis of variance was performed using the NWAY 1 computer program (STATJOB statistical series) for general analysis of variance. The results of the analysis are presented in Table 10. Statistically significant results are evident for the main effect of mental age

Table 7

Mean Concept Attainment Scores on the Concrete Level Subtest

	Mental Classification					
	Normal	N	EMR	N	$\bar{X}$ Totals for Levels of MA	N
Low MA	7.70 (.60)	40	7.20 (1.69)	40	7.45 (1.29)	80
High MA	7.80 (1.11)	40	7.82 (.54)	40	7.81 (.87)	80
$\bar{X}$ Totals for Normal/EMR	7.75 (.89)	80	7.51 (1.29)	80	7.63 (1.11)	160

Note. - Standard deviations are given in parentheses.

Table 8

Mean Concept Attainment Scores on the Concrete Level Subtest
Normal and Educable Mentally Retarded Subjects According to Treatments

	Treatments									
	I	N	II	N	III	N	IV	N	$\bar{X}$ Total	N
Normal	7.75 (.44)	20	7.90 (.30)	20	7.45 (1.66)	20	7.90 (.30)	20	7.75 (.89)	80
EMR	7.50 (1.79)	20	7.60 (1.18)	20	7.55 (.99)	20	7.40 (1.14)	20	7.51 (1.29)	80
$\bar{X}$ Total	7.62 (1.29)	40	7.75 (.86)	40	7.50 (1.35)	40	7.65 (.86)	40	7.63 (1.11)	160

Note. - Standard deviations are given in parentheses.

Table 9

Mean Concept Attainment Scores on the Concrete Level Subtest for Low and High MA Subjects According to Treatments

	Treatments									
	I	N	II	N	III	N	IV	N	$\bar{X}$ Total	N
Low MA	7.35 (1.78)	20	7.55 (1.19)	20	7.50 (1.00)	20	7.40 (1.14)	20	7.45 (1.29)	80
High MA	7.90 (.30)	20	7.95 (.22)	20	7.50 (1.67)	20	7.90 (.30)	20	7.81 (.87)	80
$\bar{X}$ Total	7.62 (1.29)	40	7.75 (.86)	40	7.50 (1.35)	40	7.65 (.86)	40	7.63 (1.11)	160

Note. – Standard deviations are given in parentheses.

Table 10

Analysis of Variance on the Concept Attainment Scores of the Concrete Level Subtest

Source	df	MS	F
Normal/EMR	1	2.256	1.786
Mental Age	1	5.256	4.161*
Treatment	3	.422	.334
Normal/EMR x Mental Age	1	2.756	2.182
Normal/EMR x Treatment	3	.622	.493
Mental Age x Treatment	3	.622	.493
Normal/EMR x Mental Age x Treatment	3	.022	.018
Within Cells	144	1.263	

*p < .05

($F = 4.161$, df = 1/144, $p < .05$). Statistical significance was not obtained for the main effects of mental classification or treatment, nor for any of the possible interactions.

Performance on the Identity Level

The mean number of correct responses on the identity level subtest according to mental classification (normal or educable mentally retarded) and mental age (low or high) is presented in Table 11. (The number of correct responses for each subject can be located in Appendix H.) As was found in examining performance on the concrete level subtest, the normals had a mean score higher than the educable retardates (7.71 vs. 7.48) and high MA boys had a mean score higher than low MA boys (7.76 vs. 7.43, respectively).

As before, the effects of the four experimental treatments were analyzed first according to mental classification and secondly according to mental age. Table 12 illustrates the mean scores of both normal and educable mentally retarded subjects according to treatments, while Table 13 illustrates mean scores of the subjects according to low vs. high mental age and treatments.

The results of the analysis of variance of the total number of correct responses on the identity level subtest is shown in Table 14. The analysis indicated statistical significance for the main effects of mental age ($F = 4.309$, df = 1/144, $p < .05$). Significant results were not obtained for the main effects of mental classification or treatment, nor for any of the possible interactions.

Performance on the Classificatory Level

Table 15 presents the mean number of correct responses on the classificatory level subtest according to normal vs. retarded mental

Table 11

Mean Concept Attainment Scores on the Identity Level Subtest

	Mental Classification					
	Normal	N	EMR	N	$\bar{X}$ Totals for Levels of MA	N
Low MA	7.70 (.72)	40	7.17 (1.33)	40	7.43 (1.10)	80
High MA	7.72 (1.13)	40	7.80 (.51)	40	7.76 (.87)	80
$\bar{X}$ Totals for Normal/EMR	7.71 (.94)	80	7.48 (1.05)	80	7.60 (1.00)	160

Note. - Standard deviations are given in parentheses.

Table 12

Mean Concept Attainment Scores on the Identity Level Subtest for Normal and Educable Mentally Retarded Subjects According to Treatments

	Treatments									
	I	N	II	N	III	N	IV	N	$\bar{X}$ Total	N
Normal	7.80 (.41)	20	7.85 (.36)	20	7.35 (1.75)	20	7.85 (.36)	20	7.71 (.94)	80
EMR	7.35 (1.46)	20	7.65 (.74)	20	7.20 (1.15)	20	7.75 (.63)	20	7.48 (1.05)	80
$\bar{X}$ Total	7.57 (1.08)	40	7.75 (.58)	40	7.27 (1.46)	40	7.80 (.51)	40	7.60 (1.00)	160

Note. – Standard deviations are given in parentheses.

Table 13

Mean Concept Attainment Scores on the Identity Level Subtest for Low and High MA Subjects According to Treatments

	Treatments									
	I	N	II	N	III	N	IV	N	$\bar{X}$ Total	N
Low MA	7.30 (1.45)	20	7.65 (.74)	20	7.15 (1.30)	20	7.65 (.67)	20	7.43 (1.10)	80
High MA	7.85 (.36)	20	7.85 (.36)	20	7.40 (1.63)	20	7.95 (.22)	20	7.76 (.87)	80
$\bar{X}$ Total	7.57 (1.08)	40	7.75 (.58)	40	7.27 (1.46)	40	7.80 (.51)	40	7.60 (1.00)	160

Note. - Standard deviations are given in parentheses.

Table 14

Analysis of Variance on the Concept Attainment Scores of the Identity Level Subtest

Source	df	MS	F
Normal/EMR	1	2.025	2.065
Mental Age	1	4.225	4.309*
Treatment	3	2.250	2.294
Normal/EMR x Mental Age	1	3.600	3.671
Normal/EMR x Treatment	3	.241	.246
Mental Age x Treatment	3	.241	.246
Normal/EMR x Mental Age x Treatment	3	.383	.390
Within Cells	144	.980	

*p < .05

Table 15

Mean Concept Attainment Scores
on the Classificatory Level Subtest

	Mental Classification					
	Normal	N	EMR	N	$\bar{X}$ Totals for Levels of MA	N
Low MA	2.20 (.91)	40	2.45 (.98)	40	2.32 (.95)	80
High MA	2.72 (.59)	40	2.77 (.57)	40	2.75 (.58)	80
$\bar{X}$ Totals for Normal/EMR	2.46 (.81)	80	2.61 (.81)	80	2.53 (.81)	160

Note. - Standard deviations are given in parentheses.

development and for low and high MA. (The number of correct responses for each subject can be found in Appendix H.) While on the concrete and identity levels subtests, normal subjects had a mean score higher than EMR subjects; on the classificatory level subtest, EMR boys had a mean score higher than normal boys (2.61 vs. 2.46). Being consistent with the two previous findings, high MA subjects had a mean score higher than low MA subjects (2.75 vs. 2.32, respectively).

The effect of the various treatments was analyzed according to mental classification and mental age. Table 16 illustrates the mean scores of both normal and EMR subjects according to treatments while Table 17 illustrates the mean scores of low and high MA subjects with respect to treatment condition.

An analysis of variance was conducted on the total number of correct responses on the classificatory level subtest. The results of the analysis are shown in Table 18. As was previously found, the main effect of mental age was statistically significant ($F = 12.356$, $df = 1/144$, $p < .001$) while the main effects of normal vs. retarded mental development and treatment were not statistically significant. The interaction of normal/EMR x treatment was the only interaction found to be statistically significant ($F = 3.164$, $df = 1.144$, $p < .05$).

A post hoc comparison of means was conducted using Tukey's (1949) procedure for pairwise comparisons. Table 19, which presents the results of the Tukey analysis on the interaction of normal/EMR x treatment, indicates that statistically significant differences were observed among the various treatment means. Figure 2 graphically illustrates this interaction.

Table 16

Mean Concept Attainment Scores on the Classificatory Level Subtest for Normal and Educable Mentally Retarded Subjects According to Treatments

	Treatments									
	I	N	II	N	III	N	IV	N	$\bar{X}$ Total	N
Normal	2.65 (.67)	20	2.70 (.65)	20	2.15 (.98)	20	2.35 (.81)	20	2.46 (.81)	80
EMR	2.80 (.52)	20	2.30 (1.17)	20	2.80 (.52)	20	2.55 (.82)	20	2.61 (.81)	80
$\bar{X}$ Total	2.72 (.59)	40	2.50 (.96)	40	2.47 (.84)	40	2.45 (.81)	40	2.53 (.81)	160

Note. - Standard deviations are given in parentheses.

Table 17

Mean Concept Attainment Scores on the Classificatory Level Subtest for Low and High MA Subjects According to Treatments

	Treatments									
	I	N	II	N	III	N	IV	N	$\bar{X}$ Total	N
Low MA	2.70 (.65)	20	2.35 (1.08)	20	2.10 (.96)	20	2.15 (.98)	20	2.32 (.95)	80
High MA	2.75 (.55)	20	2.65 (.81)	20	2.85 (.48)	20	2.75 (.44)	20	2.75 (.58)	80
$\bar{X}$ Total	2.72 (.59)	40	2.50 (.96)	40	2.47 (.84)	40	2.45 (.81)	40	2.53 (.81)	160

Note. - Standard deviations are given in parentheses.

Table 18

Analysis of Variance on the Concept Attainment Scores of the Classificatory Level Subtest

Source	df	MS	F
Normal/EMR	1	.900	1.539
Mental Age	1	7.225	12.356*
Treatment	3	.641	1.097
Normal/EMR x Mental Age	1	.400	.684
Normal/EMR x Treatment	3	1.850	3.164**
Mental Age x Treatment	3	.975	1.667
Normal/EMR x Mental Age x Treatment	3	.883	1.510
Within Cells	144	.584	

*p < .001
**p < .05

Table 19

Post Hoc Comparisons for the Treatment x Normal/EMR Interaction on the Classificatory Level Subtest

	Treatment x Normal/EMR							
	EMR_1	EMR_3	N_2	N_1	EMR_4	N_4	EMR_2	N_3
Mean	2.80	2.80	2.70	2.65	2.55	2.35	2.30	2.15
EMR_1 = 2.80	____	.00	.10	.15	.25	.45	.50	.65*
EMR_3 = 2.80		____	.10	.15	.25	.45	.50	.65*
N_2 = 2.70			____	.05	.15	.35	.40	.55*
N_1 = 2.65				____	.10	.30	.35	.50
EMR_4 = 2.55					____	.20	.25	.40
N_4 = 2.35						____	.05	.20
EMR_2 = 2.30							____	.15
N_3 = 2.15								____

Note. - Tukey HSD = .55
*p < .10

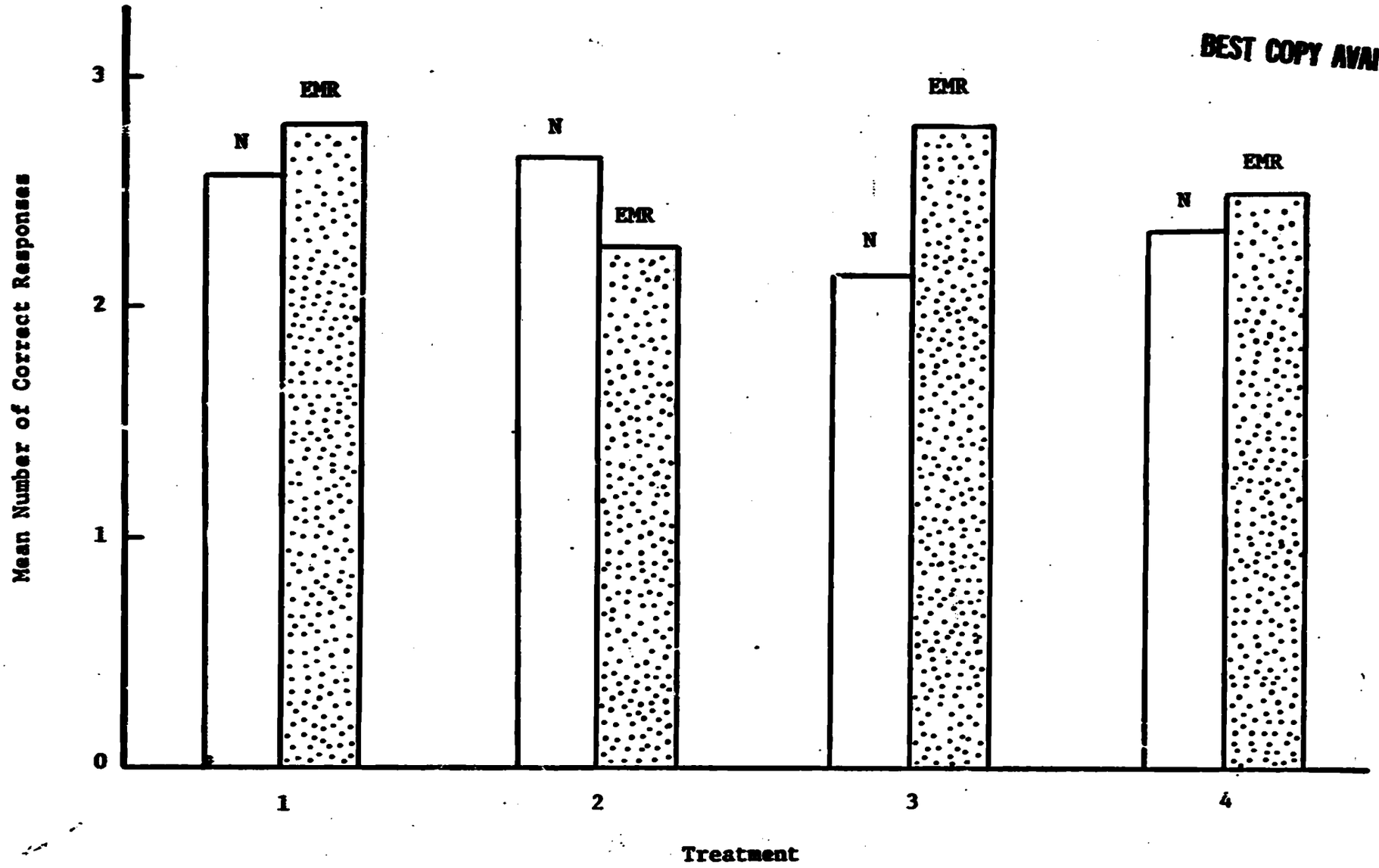


Figure 2. Interaction of normal/EMR x treatment on the classificatory level subtest.

An examination of Table 19 indicates that EMR subjects assigned to treatment I (pentagon) performed significantly better than normal subjects assigned to treatment III (verbal labels only). Furthermore, EMR subjects assigned to treatment III had a significantly higher mean score than normal subjects assigned to treatment III (2.80 vs. 2.15, respectively). The Tukey analysis also indicated that normal subjects who received instruction on equilateral triangle labels (treatment II) performed significantly better than normal subjects who received verbal labels only (treatment III). All other pairwise comparisons were non-significant at the .10 level.

Performance on the Formal Level

The performance of the subjects on the formal level subtest was analyzed according to the two measures which constitute the formal level subtest, (1) discriminating attributes and (2) vocabulary.

Discriminating Attributes

Table 20 illustrates the mean number of correct responses for normal and educable mentally retarded subjects and for subjects of low or high mental age on the discriminating attribute measure. (The number of correct responses for each subject can be located in Appendix H.) As was found on the concrete and identity level subtests, normal boys had a mean score higher than EMR boys (1.50 vs. 1.43). Being consistent with the findings reported for the three prior subtests, high MA subjects had a mean score higher than their low MA counterparts (1.67 vs. 1.26, respectively).

The effects of the four treatments were analyzed according to the mental classification and mental age of the subjects. Table 21 presents

Table 20

Mean Concept Attainment Scores on the Formal Level Subtest (Discriminating Attributes)

	Mental Classification					
	Normal	N	EMR	N	$\bar{X}$ Totals for Levels of MA	N
Low MA	1.35 (1.07)	40	1.17 (.95)	40	1.26 (1.01)	80
High MA	1.65 (1.05)	40	1.70 (1.18)	40	1.67 (1.11)	80
$\bar{X}$ Totals for Normal/EMR	1.50 (1.06)	80	1.43 (1.10)	80	1.46 (1.08)	160

Note. - Standard deviations are given in parentheses.

the mean scores of the normal and EMR subjects with regard to the various treatment conditions, while Table 22 illustrates the mean scores of the low and high MA subjects with respect to treatments.

Table 23 presents the results of the analysis of variance conducted on the total number of correct responses. The table indicates, as has been noted for all the analyses so far conducted, statistically significant results are evident for the main effect of mental age ($F = 5.782$, df = 1/144, $p < .05$). Statistical significance was not obtained for the main effects of mental classification or treatment, nor for any of the possible interactions.

Vocabulary

The mean number of correct responses on the seven item vocabulary measure according to normal vs. retarded mental development and low vs. high MA is presented in Table 24. (The number of correct responses for each subject can be located in Appendix H.) As previously noted on the classificatory level subtest, the educable retardates had a mean score higher than the normal subjects (2.77 vs. 2.57). Furthermore, it was observed that high MA subjects had a mean score higher than the low MA subjects (2.98 vs. 2.36, respectively).

Table 25 and 26 present the mean scores according to treatment condition for mental classification and mental age.

The analysis of variance conducted on the total number of correct responses revealed statistical significance for the main effects of mental age ($F = 15.183$, df = 1/144, $p < .001$) and treatment ($F = 41.379$, df = 3/144, $p < .001$). The main effect of normal vs. retarded mental development was not statistically significant. The interaction of mental

Table 21

Mean Concept Attainment Scores on the Formal Level Subtest for Normal and Educable Mentally Retarded Subjects According to Treatments (Discriminating Attributes)

	Treatments									
	I	N	II	N	III	N	IV	N	$\bar{X}$ Total	N
Normal	1.65 (1.08)	20	1.55 (1.19)	20	1.40 (.94)	20	1.40 (1.09)	20	1.50 (1.06)	80
EMR	1.30 (1.08)	20	1.35 (1.04)	20	1.30 (1.17)	20	1.80 (1.10)	20	1.43 (1.10)	80
$\bar{X}$ Total	1.47 (1.08)	40	1.45 (1.10)	40	1.35 (1.05)	40	1.60 (1.10)	40	1.46 (1.08)	160

Note. - Standard deviations are given in parentheses.

Table 22

Mean Concept Attainment Scores on the Formal Level Subtest for Low and High MA Subjects According to Treatments (Discriminating Attributes)

	Treatments									
	I	N	II	N	III	N	IV	N	$\bar{X}$ Total	N
Low MA	1.40 (.94)	20	1.20 (1.10)	20	1.10 (.85)	20	1.35 (1.18)	20	1.26 (1.01)	80
High MA	1.55 (1.23)	20	1.70 (1.08)	20	1.60 (1.18)	20	1.85 (.98)	20	1.67 (1.11)	80
$\bar{X}$ Total	1.47 (1.08)	40	1.45 (1.10)	40	1.35 (1.05)	40	1.60 (1.10)	40	1.46 (1.08)	160

Note. – Standard deviations are given in parentheses.

Table 23

Analysis of Variance on the Concept Attainment Scores of the Formal Level Subtest (Discriminating Attributes)

Source	df	MS	F
Normal/EMR	1	.156	.132
Mental Age	1	6.806	5.782*
Treatment	3	.422	.359
Normal/EMR x Mental Age	1	.506	.433
Normal/EMR x Treatment	3	1.056	.897
Mental Age x Treatment	3	.306	.260
Normal/EMR x Mental Age x Treatment	3	1.172	.996
Within Cells	144	1.177	

*p < .05

Table 24

Mean Concept Attainment Scores on the Formal Level Subtest (Vocabulary)

	Mental Classification					
	Normal	N	EMR	N	$\bar{X}$ Totals for Levels of MA	N
Low MA	2.20 (1.60)	40	2.52 (1.63)	40	2.36 (1.61)	80
High MA	2.95 (1.01)	40	3.02 (1.14)	40	2.98 (1.07)	80
$\bar{X}$ Totals for Normal/EMR	2.57 (1.38)	80	2.77 (1.42)	80	2.67 (1.40)	160

Note. - Standard deviations are given in parentheses.

Table 25

Mean Concept Attainment Scores on the Formal Level Subtest for Normal and Educable Mentally Retarded Subjects According to Treatments (Vocabulary)

	Treatments									
	I	N	II	N	III	N	IV	N	$\bar{X}$ Total	N
Normal	3.00 (.64)	20	3.90 (.91)	20	1.90 (1.21)	20	1.50 (1.23)	20	2.57 (1.38)	80
EMR	3.20 (.76)	20	3.90 (1.41)	20	2.35 (1.38)	20	1.65 (.93)	20	2.77 (1.42)	80
$\bar{X}$ Total	3.10 (.70)	40	3.90 (1.17)	40	2.12 (1.30)	40	1.57 (1.08)	40	2.67 (1.40)	160

Note. - Standard deviations are given in parentheses.

Table 26

Mean Concept Attainment Scores on the Formal Level Subtest for Low and High MA Subjects According to Treatments (Vocabulary)

	Treatments									
	I	N	II	N	III	N	IV	N	$\bar{X}$ Total	N
Low MA	2.95 (.75)	20	3.95 (1.39)	20	1.60 (1.42)	20	.95 (.75)	20	2.36 (1.61)	80
High MA	3.25 (.63)	20	3.85 (.93)	20	2.65 (.93)	20	2.20 (1.00)	20	2.98 (1.07)	80
$\bar{X}$ Total	3.10 (.70)	40	3.90 (1.17)	40	2.12 (1.30)	40	1.57 (1.08)	40	2.67 (1.46)	160

Note. – Standard deviations are given in parentheses.

age x treatment was significant at the .01 level ($F = 3.89$, df = 3/144, $p < .01$) while all other possible interactions were non-significant. Table 27 presents the results of the analysis of variance in table format.

A post hoc comparison of the treatment means was conducted using the procedure advocated by Tukey. Table 28 indicates the results of the analysis. As hypothesized, the mean number of correct responses for treatment II (3.90, equilateral triangle) was found to be significantly higher than treatments I (3.10, pentagon), III (2.12, verbal labels only), and IV (1.57, cutting tool--control). Treatment I was also found to be significantly different than treatments III and IV. The remaining pairwise comparison was not found to be statistically significant.

Table 29 illustrates the results of a post hoc comparison of means conducted on the interaction of mental age x treatment. Examination of the table indicates that low MA subjects assigned to treatment II (equilateral triangle) performed significantly better than all other subjects regardless of mental age or treatment. The only exceptions to this finding were the high MA subjects who received treatment II (equilateral triangle) or treatment I (pentagon). Furthermore, high MA subjects assigned to treatment II had a significantly higher mean score (3.85) as compared to high MA subjects who received treatments III and IV (mean scores; 2.65 and 2.20, respectively) and low MA subjects who also received treatments III and IV (mean scores; 1.60 and .95, respectively). The results of the Tukey analysis indicated other additional significant differences, (1) high MA subjects assigned to treatment I (pentagon) performed significantly better than either high MA control subjects

Table 27

Analysis of Variance on the Concept Attainment Scores of the Formal Level Subtest (Vocabulary)

Source	df	MS	F
Normal/EMR	1	1.600	1.554
Mental Age	1	15.625	15.183*
Treatment	3	42.583	41.379*
Normal/EMR x Mental Age	1	.625	.607
Normal/EMR x Treatment	3	.350	.340
Mental Age x Treatment	3	4.008	3.894**
Normal/EMR x Mental Age x Treatment	3	2.075	2.016
Within Cells	144	1.029	

*p < .001
**p < .01

Table 28

Post Hoc Comparisons for the Treatment Main Effect on the Formal Level Subtest (Vocabulary)

	Treatment			
	2	1	3	4
Mean	3.90	3.10	2.12	1.57
2 = 3.90	____	.80*	1.78*	2.33*
1 = 3.10		____	.98*	1.53*
3 = 2.12			____	.55
4 = 1.57				____

Note. - Tukey HSD = .586
*p < .05

Table 29

Post Hoc Comparisons for the Treatment x Mental Age Interaction on the Formal Level Subtest (Vocabulary)

	Treatment x Mental age							
	Low_2	$High_2$	$High_1$	Low_1	$High_3$	$High_4$	Low_3	Low_4
Mean	3.95	3.85	3.25	2.95	2.65	2.20	1.60	.95
Low_2 = 3.95	____	.10	.70	1.00*	1.30*	1.75*	2.35*	3.00*
$High_2$ = 3.85		____	.60	.90	1.20*	1.65*	2.25*	2.90*
$High_1$ = 3.25			____	.30	.60	1.05*	1.65*	2.30*
Low_1 = 2.95				____	.30	.75	1.35*	2.00*
$High_3$ 2.65					____	.45	1.05*	1.70*
$High_4$ = 2.20						____	.65	1.25*
Low_3 = 1.60							____	.65*
Low_4 = .95								____

Note. - Tukey HSD = .980
*p < .05

(treatment IV) or low MA subjects assigned to treatments III or IV (verbal labels only and cutting tool--control, respectively), (2) low MA subjects assigned to treatment I had a significantly higher mean score (2.95) as compared to low MA subjects who received treatments III and IV (mean scores; 1.60 and .95, respectively), (3) high MA subjects assigned to the verbal labels only treatment (treatment III) performed significantly better than low MA subjects assigned either treatment III or IV, (4) high MA control subjects performed significantly better than low MA control subjects, and (5) low MA subjects who received verbal labels only performed significantly better than low MA control subjects. All other pairwise comparisons were non-significant at the .05 level.

Figure 3 graphically illustrates this interaction.

Subjects' Time-on-Task

As was previously indicated, a measure of the subjects' attentiveness (i.e., time-on-task) was taken at randomly selected intervals during the experiment. (A copy of the measure used to assess the degree of attentiveness is located in Appendix F.) A total of 19 subjects, or approximately 12% of the subjects involved in the experiment, were observed. Measurements were taken at two minute intervals. The subjects were rated according to the percent of time they were on task. Table 30 presents the mean percent attention per minute. It is obvious that the subjects were attending at an exceptionally high level thus indicating that time-off-task was at a minimum.

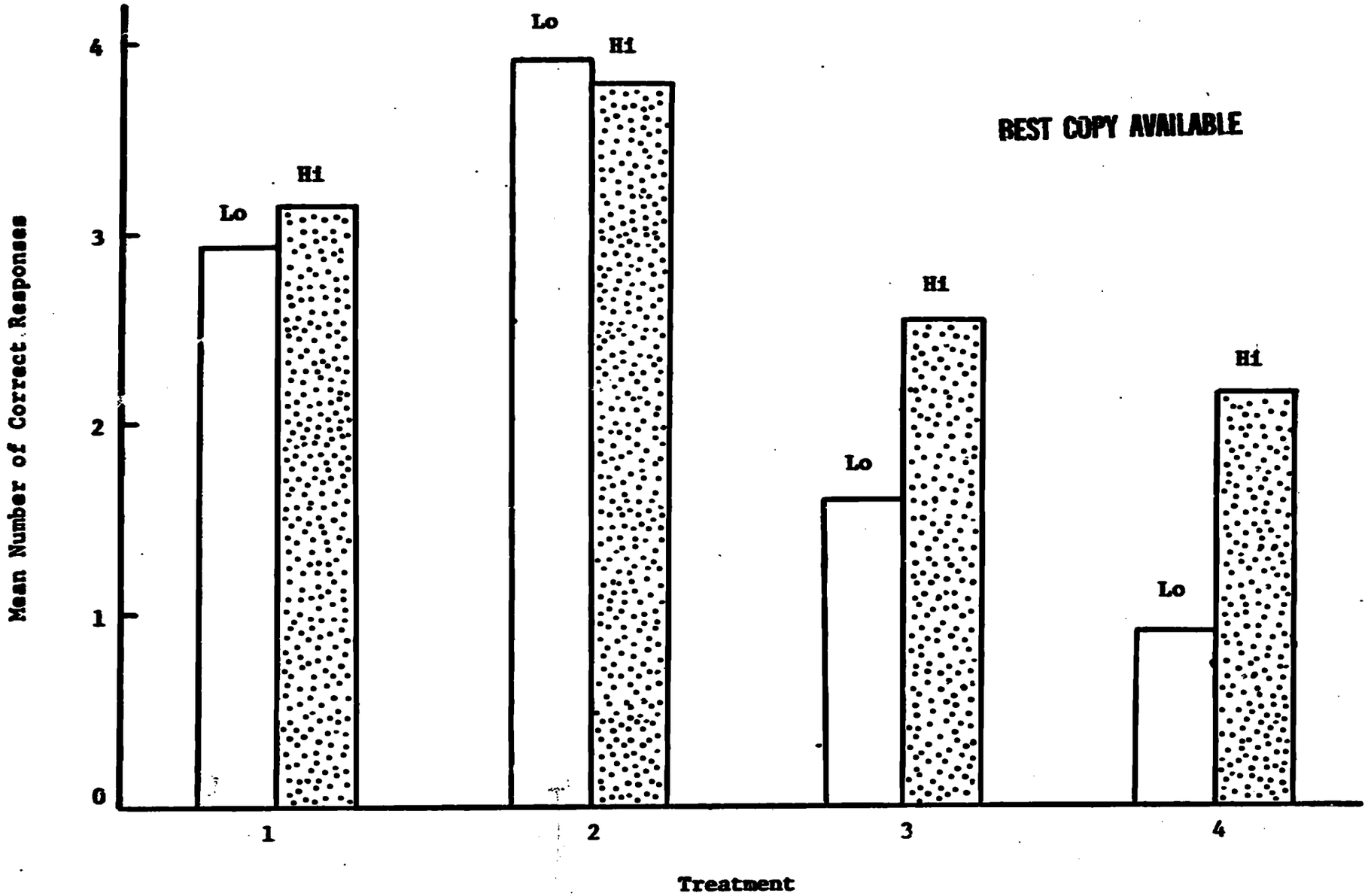


Figure 3. Interaction of mental age x treatment on the formal level subtest (vocabulary).

Table 30

Mean Percent Attention Per Minute

	Minutes						
	2	4	6	8	10	12	14
Mean	100	97.37	96.05	97.37	97.37	98.68	98.68
Standard Deviation	0.00	7.88	9.37	7.88	7.88	5.74	5.74
N	19	19	19	19	19	19	19

Evaluation of Classroom Instruction

All teachers whose students participated in the experiment received an evaluation form which sought to ascertain whether or not the subjects had received instruction on the labels presented in the current experiment. (A copy of the questionnaire is located in Appendix G.) Nineteen of the 21 teachers (90.47%) involved in the study responded to the questionnaire.

None of the teachers, neither those responsible for teaching the first and third graders nor those involved in educating the educable mentally retarded boys, indicated that their students had received instruction on the following labels: polygon, pentagon, regular pentagon, perimeter, and simple figures. Two third grader teachers indicated that their students received instruction on the labels: open figure, closed figure, angle, and equilateral triangle one month prior to the initiation of the experimental treatments. All of the teachers involved indicated that instruction was continously provided on the labels: triangle, shape, sides, equal, three, and five.

An examination of the appropriate curriculum guides and arithmetic textbooks indicated that the only labels on which instruction is provided for the first grade and primary EMR subjects are: triangle, shape, sides, equal, three, and five. An examination of the third graders' texts and the arithmetic books used by the intermediate EMR subjects indicated that instruction is to be provided on the labels: polygon, pentagon, angle, triangle, shape, sides, equal, three, and five. (The experimenter was unable to determine though at which point in the math curriculum instruction on the labels was to begin.)

Thus, the assumption that the subjects were unfamiliar with most of the labels prior to the experiment is supported both by teacher opinion and the examination of the appropriate curriculum guides and textbooks.

Chapter V

DISCUSSION

The major objective of the present study was to investigate the effects of two kinds of instructions and verbal labels on the concept attainment of educable mentally retarded and normally developing boys of the same mental age. The concept examined was that of equilateral triangle. The specific questions which the experiment sought to answer were:

1. What is the effect of normal vs. retarded mental development on concept attainment?

2. What is the effect of higher vs. lower mental age on concept attainment?

3. What is the effect of various kinds of instruction on concept attainment?

4. Is there an interaction between level of mental age and normal vs. retarded mental development?

5. Is there an interaction between kinds of instruction and normal vs. retarded mental development?

6. Is there an interaction between kinds of instruction and higher vs. lower mental age?

7. Is there an interaction among kinds of instruction, normal vs. retarded mental development, and higher vs. lower mental age?

Based upon the preceding questions the following hypotheses were offered for each of the main effect questions.

1. There will be no difference between normally developing and mentally retarded boys on concept attainment.

2. Higher MA boys will perform significantly better than lower MA boys on concept attainment.

3. The rank order of the treatments from lowest to highest will be control, verbal labels only, verbal labels with instruction pertaining to pentagon, and verbal labels with instruction pertaining to equilateral triangle; also the last two treatments will result in significantly higher concept attainment than the control group.

No hypotheses were formulated for questions 4-7.

The following conclusions are based upon the results presented in Chapter IV for performance according to the five concept attainment subtests.

First, statistically significant differences were not observed between the mean scores of the educable retardates and normally developing boys on any of the concept attainment measures. This therefore indicates that the normal subjects and educable mentally retarded subjects performed equally well on the various dependent measures. This substantiates the hypothesis that no difference will be found between normally developing and mentally retarded boys on concept attainment. This conclusion is in agreement with that of Stephens (1966) and Landau (1968), both of whom found no difference in performance between educable retardates and normal subjects on concept learning tasks when appropriate verbal cues were provided.

A related statistically significant interaction was observed, that being the interaction of normal/EMR x treatment on the three item classificatory level subtest (Table 19). This interaction is at best difficult to explain.

The normal subjects performed somewhat as anticipated. This was directly related to the nature of the experimental treatments.

The finding that EMR subjects who received treatment I had a significantly higher mean score than the educable retardates who received treatment III can be explained as being due to the nature of the treatments that the subjects received. The same explanation appears valid for comparing the performance of the normal subjects who received treatment II vs. the normal subjects who received treatment III. A reasonable explanation is not readily available though to explain why the EMR subjects who received verbal labels only performed better than the normal subjects who received the same treatment. It is noted though that the Tukey analysis was conducted at the .10 level.

Of greater interest to the investigator than the above significant interactions is the finding that the educable retardates who received treatment II performed the poorest in comparison to the other EMR subjects. An examination of the raw data indicated that three of the 20 subjects who received treatment II did not respond correctly to any of the items included in the measure. The experimenter hypothesizes that for some reason these subjects did not understand the instructions or the task itself. A further possibility is that for some reason the treatment actually hindered their performance rather than enhanced it. A more logical possibility is that since the three subjects who performed so poorly were low MA educable retardates the required classificatory behaviors necessary to perform successfully were beyond their conceptual ability.

Secondly, statistically significant differences were obtained when the performance of high MA subjects was compared to that of low MA subjects,

thereby confirming the second hypothesis of a significant performance difference between high and low MA boys. This difference was observed on each of the five measures. Thus it would appear that the mental age of the subject, rather than being retarded or normal, was the determining factor in task performance.

An accompanying significant interaction of mental age x treatment on the vocabulary measure can best be viewed as the effect of mental age being qualified according to treatments. As Table 29 indicates, the treatments which had the greatest effect (equilateral triangle and pentagon) decreased the differences in the mean scores between the high and low MA subjects to the point of non-significance (in fact, low MA treatment II subjects had a mean score higher than high MA treatment II subjects). On the other hand, for those subjects that received verbal labels only or instruction on cutting tools, the differences in mean scores between the high and low MA subjects were greater and statistically significant. This would tend to suggest that the most powerful treatments (equilateral triangle and pentagon) were equally effective regardless of mental age.

Third, hypothesis three was confirmed for performance on the vocabulary measure of the formal level, but was completely unsubstantiated on the remaining four measures. Specifically, the rank order of the treatments (lowest to highest) was (1) cutting tool (control group), (2) verbal labels only, (3) verbal labels pertaining to pentagon with instruction, and (4) verbal labels pertaining to equilateral triangle with instruction. These findings are similar to those reported by Prehm (1966). Prehm found that subjects who received a verbal cue relevant to the concept being studied performed better than subjects assigned to an "attention" group

who in turn performed better than the control group. (See Chapter II for a more complete description of Prehm's work.)

Fourth, it is noted that overall the treatments affected only a narrow range of concept attainment. The investigator hypothesizes that the lack of treatment effect may possibly be due to the observed ceiling effect on the concrete and identity subtest and therefore the treatments could not be expected to influence performance. Furthermore, it is possible that the nature of some of the measures (i.e., classificatory and discriminating attributes) allowed the subjects to respond on a perceptual rather than a strictly conceptual basis.

Lastly, the experimenter is aware of the fact that the findings of this study are limited in terms of their generalizability. The experimental subjects were all boys of a mixed racial composition, of low socioeconomic status, and were growing up in school neighborhood environments characteristic of a large northern city of some 1,000,000 population. The conclusions of this study would seem to be generalizable to boys of similar characteristics in similar environments.

Educational Implications

The results of the present study offer some suggestions for both the classroom teacher and curriculum specialist alike. A major objective of teaching is getting the student to learn efficiently. One finding of the experiment was that high MA boys performed significantly better than boys of low MA. It would seem, therefore, that the mental age of the student may be used in predicting concept attainment. If other measures are not available the mental age of the student should be considered when planning

instruction dealing with concepts.

Secondly, a significant difference between the concept attainment of the normal boys and educable retardates was not found. This would seem to imply that normally developing boys and educable mentally retarded boys of about the same mental age could be taught together in the same instructional groups provided that differences in chronological ages did not present difficulties. If the two categories of boys were not grouped for instruction, it would seem that teachers of the retarded might use instructional materials and techniques for teaching concepts that are also appropriate for normally developing boys of the same mental age. In the present study the experimental materials and techniques appeared equally effective with both groups.

Finally, the experimental treatments emphasized verbal labels. These treatments did not facilitate concept attainment as well as was hypothesized, particularly with the retardates. Based on this result it would seem that to improve concept attainment one should educate children on the various mental operations involved in conceptualizing.

Appendix A

Instructional Lessons

Pilot Study

Treatment: 1 Lesson on Geometric Figures

Instructions to Students

Good morning (afternoon) boys.

My name is _____. I work at the University of Wisconsin in Madison. At the university, people are studying how children learn. You can help us in our work by answering some questions for me. I am going to give you a booklet with some questions. Please do not open the booklet until I ask you to do so. I want you to do a good job in answering the questions. By doing a good job, you can help me find out what you know. As I call your name, raise your hand, and I will give you a booklet. Remember do not open the booklet until I ask you to do so. (E distributes the booklets and a pencil to the Ss. E slowly reads the instructions to the Ss as outlined in the directions for administering the test.)

When the questions are answered, the E tells the Ss that they did a good job. The E then invites the Ss to stand up and stretch -- see if you can touch the ceiling. As the Ss are stretching, the E collects the booklets.

The E then asks the Ss to join him near a small table where a flannel board is set up. The Ss will be asked to sit on the floor in a semi-circular fashion facing the flannel board. The E tells the Ss that he is going to show the Ss some words and that the E would like the Ss to look at the words and study them.

Verbal Labels:

polygons
pentagon
regular pentagon
five
sides
angle
equal
shape
perimeter
simple figures
open figure
closed figure

The E presents each word individually and allows the Ss to view the words for 5 seconds. Upon completion of the aforesaid activity, the E informs the Ss that he is going to say the words out loud, and that the Ss should repeat each word out loud. Then both the E and the Ss will say the words out loud together. (E presents each word individually and initiates the activity.) Upon completion of the activity, the E tells the Ss that it would be fun to do it again, but first the E would like to mix the words up. (E shuffles the order of the word cards and repeats the previous procedure. Approximate time for completion of the above activities: 4 1/2 - 5 minutes.)

After the introduction of the verbal labels, the E provides information about the characteristics of a pentagon. The E tells the Ss that he would like to talk to them about a very special kind of pentagon. (E places the appropriate verbal label word card on the flannel board, pronounces it, and asks the Ss to repeat it twice. The E will verbally reinforce the Ss after each response.) The E tells the Ss that the special kind of pentagon we are going to talk about is called a regular pentagon. (E places a large regular pentagon [each side 3 13/16 inches] on the flannel board. Beneath the pentagon, the E places the appropriate verbal label word card. The E pronounces the word asking the Ss to repeat 'regular pentagon' twice. The E will verbally reinforce the Ss after each pronunciation.) Next, the E points to the sides of the pentagon one at a time, and asks the Ss if they know to what the E is pointing. (E awaits response from the Ss. If the Ss supply the correct response, i.e., the sides, the E will verbally reinforce the Ss and repeat the response, placing the appropriate verbal label word card on the flannel board. If an inappropriate response is given, the E supplies the correct

response and asks the Ss to repeat the response.) The E then tells the Ss that a pentagon has five sides, and this pentagon has all of the sides the same length, or we can say that the sides of this pentagon are equal. (E says 'five' and 'equal' as he places the appropriate verbal label word card on the flannel board, asking the Ss to repeat each word. The E will verbally reinforce the Ss after each response. The E then counts the sides of the pentagon, pointing to each side. The E also shows the Ss that the sides of the pentagon are of the same length.) The E then explains to the Ss that when the sides of a pentagon come together, the sides form an angle. (The E places the appropriate verbal label word card on the flannel board and pronounces the word as he points to the angles of the pentagon. The E asks the Ss to repeat the word, verbally reinforcing the Ss for their response.) Next, the E asks the Ss how many angles does a pentagon have? (E awaits response from the Ss. If the Ss supply the correct response, i.e., five angles, the E will verbally reinforce the Ss and repeat the response. If an inappropriate response is given, the E supplies the correct response and asks the Ss to repeat the response.) The E then places a small regular pentagon (each side 1 11/32 inches) and a medium-size regular pentagon (each side 2 9/16 inches) of different colors on the flannel board. The E explains to the Ss that even though these pentagons are of different sizes and colors they still look alike, or we can say they have the same shape. (E places the appropriate verbal label word card on the flannel board and pronounces the word for the Ss asking the Ss to repeat it. The E will verbally reinforce the Ss for their response. Approximate time for completion of the above activities: 4 minutes.)

For the next activity, the E places the three previously described pentagons in various positions, i.e., one pentagon pointing to the left, another pointing to the right and the third pentagon pointing "up-side down". The E explains to the Ss that it doesn't make any difference what position the pentagons are in, they still remain pentagons. The E then places the pentagons in still other positions and asks the Ss if the pentagons still remain pentagons. (E awaits response from the Ss. If the Ss supply the correct response, the E will verbally reinforce the Ss. If an inappropriate response is given, the E will repeat the previous explanation.) Pointing to the pentagons, the E informs the Ss that pentagons are kinds of polygons. (E places the appropriate verbal label word card on the flannel board and pronounces the word, asking the Ss to repeat it. The E will verbally reinforce the Ss for their response.) The E tells the Ss that he has another word for the Ss to say. The E says perimeter and asks the Ss to repeat it. (E places the appropriate verbal label word card on the flannel board, points to it, and says 'perimeter', asking the Ss to repeat it again. The E will verbally reinforce the Ss for their response.) The E explains to the Ss that the distance around a pentagon is called its perimeter. The E will explain to the Ss that if each side of a regular pentagon is one inch long, and a pentagon has five sides, then the perimeter or distance around the pentagon will be five inches. (Approximate time for completion of described activities: 3 minutes.)

As a concluding activity to the instructional lesson, the E will point to the pentagons and tell the Ss that besides being kinds of polygons, pentagons are also kinds of simple figures. (The E will ask the Ss to say the word 'simple figures'. E then places the appropriate

verbal label word card on the flannel board, pronounces it, and asks the Ss to say the word once again. The E will verbally reinforce the Ss for their response.) The E removes the pentagons and places a 4 x 6 inch file card on the flannel board containing a line drawing of a regular pentagon (each side 1 1/2 inches). The E explains to the Ss that the drawing is a closed figure, that is, the ends of the sides touch each other forming angles. (The E will ask the Ss to say the word 'closed figure'. E then places the appropriate verbal label word card on the flannel board, pronounces it, and asks the Ss to say the word once again. The E will verbally reinforce the Ss for their response.) When some of the sides don .. touch each other we have an open figure. (The E will ask the Ss to say the word 'open figure'. E then places the appropriate verbal label word card on the flannel board, pronounces it, and asks the Ss to say the word once again. The E will verbally reinforce the Ss for their response.) The E then places three 4 x 6 inch file cards on the flannel board one at a time, each showing an incomplete pentagon--one that has one of its sides incomplete (each complete side 1 1/2 inches). The E points to the open side explaining to the Ss that this is why the drawing is called an open figure. To complete the final segment of the instructional lesson, the E will ask the Ss, as a group, the following questions:

1. How many sides does a pentagon have?
2. How many angles does a pentagon have?
3. When pentagons look alike, we say they have the same _____.
4. The distance around a pentagon is called its _____.

(If the Ss give the correct response, the E will verbally reinforce the Ss and repeat the response. If an inappropriate response is given, the

E will supply the correct response and ask the Ss to repeat the response. Approximate time for completion of the above activities: 3 - 4 minutes. Total time for instructional lesson--approximately 15 minutes.)

Upon completion of the lesson, the E will tell the Ss that they did a good job, and would they please go and stand by their desks. The E will ask the Ss to stretch -- see if you can touch the sky. The Ss will then be asked to take their seats and pay attention.

The E then tells the Ss that he would like for them to answer some questions. The E tells the Ss, as I call your name, raise your hand, and I will give you a booklet. Remember do not open it until I ask you to do so. (E distributes the booklets and a pencil to each S. The E then slowly reads the instructions to the Ss as outlined in the directions for administering the test.) When the questions are answered, the E collects the booklets from the Ss and thanks the Ss for their help. The E then returns the Ss to their classroom.

Treatment 2: Lesson on Equilateral Triangles

Instructions to Students

Good morning (afternoon) boys.

My name is _____. I work at the University of Wisconsin in Madison. At the university, people are studying how children learn. You can help us in our work by answering some questions for me. I am going to give you a booklet with some questions. Please do not open the booklet until I ask you to do so. I want you to do a good job in answering the questions. By doing a good job, you can help me find out what you know. As I call your name, raise your hand, and I will give you a booklet. Remember do not open the booklet until I ask you to do so. (E distributes the booklets and a pencil to the Ss. E slowly reads the instructions to the Ss as outlined in the directions for administering the test.)

When the questions are answered, the E tells the Ss that they did a good job. The E then invites the Ss to stand up and stretch -- see if you can touch the ceiling. As the Ss are stretching, the E collects the booklets.

The E then asks the Ss to join him near a small table where a flannel board is set up. The Ss will be asked to sit on the floor in a semi-circular fashion facing the flannel board. The E tells the Ss that he is going to show the Ss some words and that the E would like the Ss to look at the words and study them.

Verbal Labels:

polygons
triangle
equilateral triangle
three
sides
angle
equal
shape
perimeter
simple figures
open figure
closed figure

The E presents each word individually and allows the Ss to view the words for 5 seconds. Upon completion of the aforesaid activity, the E informs the Ss that he is going to say the words out loud, and that the Ss should repeat each word out loud. Then both the E and the Ss will say the words out loud together. (E presents each word individually and initiates the activity.) Upon completion of the activity, the E tells the Ss that it would be fun to do it again, but first the E would like to mix the words up. (E shuffles the order of the word cards and repeats the previous procedure. Approximate time for completion of the above activities: 4 1/2 - 5 minutes.)

After the introduction of the verbal labels. the E provides information about the characteristics of the equilateral triangle. The E places a large equilateral triangle (6 x 6 x 6 inch) on the flannel board. The E asks the Ss if they can tell the E what the shape is called. (E awaits response from the Ss. If the Ss supply the correct response, i.e., a triangle, the E will verbally reinforce the Ss and repeat the response, placing the appropriate verbal label word card on the flannel board. If an inappropriate response is given, the E supplies the correct response and asks the Ss to repeat the response.) The E then tells the Ss that this is a special kind of triangle, it is an equilateral triangle. (E places the appropriate verbal label word card on the flannel board and asks the Ss to say 'equilateral triangle' twice. The E will reinforce the Ss after each pronunciation.) Next, the E points to the sides of the equilateral triangle one at a time, and asks the Ss if they know to what the E is pointing. (E awaits response from the Ss. If the Ss supply the correct response, i.e., the sides, the E will verbally reinforce the Ss and repeat the response, placing the appropriate verbal label word card

on the flannel board. If an inappropriate response is given, the E supplies the correct response and asks the Ss to repeat the response.) The E tells the Ss that an equilateral triangle has three sides, and that all of the sides are of the same length, or we can say that the sides of an equilateral triangle are equal. (E says 'three' and 'equal' as he places the appropriate verbal label word cards on the flannel board, asking the Ss to repeat each word. The E will verbally reinforce the Ss after each response. The E then counts the sides of the triangle, pointing to each side. The E also shows the Ss that the sides of the triangle are of the same length.) The E then explains to the Ss that when the sides of a triangle come together the sides form an angle. (The E places the appropriate verbal label word card on the flannel board and pronounces the word as he points to the angles of the triangle. The E asks the Ss to repeat the word, verbally reinforcing the Ss for their response.) Next, the E asks the Ss how many angles does a triangle have? (E awaits response from the Ss. If the Ss supply the correct response, i.e., three angles, the E will verbally reinforce the Ss and repeat the response. If an inappropriate response is given, the E will supply the correct response and ask the Ss to repeat the response.) The E then places a small (2 x 2 x 2 inch) equilateral triangle and a medium-size (4 x 4 x 4 inch) equilateral triangle of different colors on the flannel board. The E explains to the Ss that even though the equilateral triangles are of different sizes and colors they still look alike, or we can say they have the same shape. (E places the appropriate verbal label word card on the flannel board and pronounces the word for the Ss, asking the Ss to repeat it. The E will verbally reinforce the Ss for their response. Approximate time for completion of the above activities: 4 minutes.)

For the next activity, the E places the three previously described equilateral triangles in various positions, i.e., one pointing to the left, another pointing to the right and the third triangle pointing "up-side down". The E explains to the Ss that it doesn't make any difference what position the equilateral triangles are in, they still remain equilateral triangles. The E then places the equilateral triangles in still other positions and asks the Ss if they still remain equilateral triangles. (E awaits response from the Ss. If the Ss supply the correct response, the E will verbally reinforce the Ss. If an inappropriate response is given, the E will repeat the previous explanation.) Pointing to the triangles, the E informs the Ss that equilateral triangles are kinds of polygons. (E places the appropriate verbal label word card on the flannel board and pronounces the word, asking the Ss to repeat it. The E will verbally reinforce the Ss for their response.) The E then tells the Ss that he has another word for the Ss to say. The E says perimeter and asks the Ss to repeat it. (E places the appropriate verbal label word card on the flannel board, points to it, and says 'perimeter', asking the Ss to repeat it again. The E will verbally reinforce the Ss for their response.) The E explains to the Ss that the distance around an equilateral triangle is called its perimeter. The E will explain to the Ss that if each side of an equilateral triangle is one inch long, and an equilateral triangle has three sides, then the perimeter or distance around the equilateral triangle will be three inches. (Approximate time for completion of described activities: 3 minutes.)

As a concluding activity to the instructional lesson, the E will point to the equilateral triangles and tell the Ss that besides being kinds of polygons, equilateral triangles are also kinds of simple figures.

(The E will ask the Ss to say the word 'simple figures'. E then places the appropriate verbal label word card on the flannel board, pronounces it, and asks the Ss to say the word once again. The E will verbally reinforce the Ss for their response.) The E removes the equilateral triangles and places a 3 x 5 inch file card on the flannel board containing a line drawing of an equilateral triangle (each side 2 inches). The E explains to the Ss that the drawing is a closed figure, that is, the ends of the sides touch each other forming angles. (The E will ask the Ss to say the word 'closed figure'. E then places the appropriate verbal label word card on the flannel board, pronounces it, and asks the Ss to say the word once again. The E will verbally reinforce the Ss for their response.) When some of the sides don't touch each other we have an open figure. (The E will ask the Ss to say the word 'open figure'. E then places the appropriate verbal label word card on the flannel board, pronounces it, and asks the Ss to say the word once again. The E will verbally reinforce the Ss for their response.) The E then places three 3 x 5 inch file cards on the flannel board one at a time, each one showing an incomplete equilateral triangle--one that has one of its sides incomplete (each complete side 2 inches). The E points to the open side explaining to the Ss that this is why the drawing is called an open figure. To complete the final segment of the instructional lesson, the E will ask the Ss as a group, the following questions:

1. How many sides does an equilateral triangle have?
2. What is special about the sides of an equilateral triangle?
3. How many angles does an equilateral triangle have?
4. When equilateral triangles look alike we say they have the same _____.
5. The distance around an equilateral triangle is called its _____.

(If the Ss give the correct response, the E will verbally reinforce the Ss and repeat the response. If an inappropriate response is given, the E will supply the correct response and ask the Ss to repeat the response. Approximate time for completion of the above activities: 3 - 4 minutes. Total time for instructional lesson--approximately 15 minutes.)

Upon completion of the lesson, the E will tell the Ss that they did a good job and would they please go and stand by their desks. The E will ask the Ss to stretch -- see if you can touch the sky. The Ss will then be asked to take their seats and pay attention.

The E then tells the Ss that he would like them to answer some questions. The E tells the Ss, as I call your name, raise your hand, and I will give you a booklet. Remember do not open the booklet until I ask you to do so. (E distributes the booklets and a pencil to each S. The E then slowly reads the instructions to the Ss as outlined in the directions for administering the test.) When the questions are answered, the E collects the booklets from the Ss and thanks the Ss for their help. The E then returns the Ss to their classroom.

Treatment 3: Labeling Lesson

Instructions to Students

Good morning (afternoon) boys.

My name is _____. I work at the University of Wisconsin in Madison. At the university, people are studying how children learn. You can help us in our work by answering some questions for me. I am going to give you a booklet with some questions. Please do not open the booklet until I ask you to do so. I want you to do a good job in answering the questions. By doing a good job, you can help me find out what you know. As I call your name, raise your hand, and I will give you a booklet. Remember do not open the booklet until I ask you to do so. (E distributes the booklets and a pencil to the Ss. E slowly reads the instructions to the Ss as outlined in the directions for administering the test.)

When the questions are answered, the E tells the Ss that they did a good job. The E then invites the Ss to stand up and stretch -- see if you can touch the ceiling. As the Ss are stretching, the E collects the booklets.

The E then asks the Ss to join him near a small table where a flannel board is set up. The Ss will be asked to sit on the floor in a semi-circular fashion facing the flannel board. The E tells the Ss that he is going to show the Ss some words and that the E would like the Ss to look at the words and study them.

Verbal Labels:

polygon	angle
pentagon	equal
regular pentagon	shape
triangle	perimeter

equilateral triangle	simple figures
five	open figure
three	closed figure
sides	

The E presents each word individually and allows the Ss to view the words for 5 seconds. Upon completion of the aforesaid activity, the E informs the Ss that he is going to say each word out loud, and that the Ss should repeat each word out loud. Then both the E and the Ss will say the words out loud together. (E presents each word individually and initiates the activity.) Upon completion of the activity, the E tells the Ss that it would be fun to do it again, but first the E would like to mix the words up. (E shuffles the order of the word cards and repeats the previous procedure. Approximate time for completion of the above activities: 4 1/2 - 5 minutes.)

Next, the E places each word card on the flannel board. The E points to the word card and pronounces the word out loud. The E then invites the Ss to come to the flannel board one at a time. The Ss will be requested to pronounce the word out loud while pointing to the word card. (If the S correctly completes the activity, the E will verbally reinforce the S. If an inappropriate response is given, the E will point to the word and say it. The S will then be asked to repeat the word.) All Ss will be called upon until the entire list of verbal labels is presented twice. (Approximate time for completion of the above activities: 4 minutes.)

The E then tells the Ss that he thinks it would be fun to say the words together one more time. The E shows the Ss the word cards one at a time and says each word out loud. The Ss are requested to repeat the words out loud. Then the E and the Ss say the words out loud together. (E shows the Ss the first word card and begins the activity.) When the

list is completed once, the E tells the Ss that he would like to do it again, but first the cards must be mixed up. (E shyffles the cards, and once again initiates the activity. Approximate time for completion of described activities: 3 minutes.)

The E then tells the Ss that they are doing a good job, and that the E is very proud of them. To assure the continuance of the Ss' attention, the E places a word card on the flannel board and asks one of the Ss if he can tell the E what it says. (If the S gives a correct response, the E will verbally reinforce the S and give the S the word card to hold. If an incorrect response is given, the E will say the word and ask the Ss to repeat it. The E then places the card back into the pile.) The E will choose both those Ss who volunteer and those Ss who do not. The E places a second word card on the flannel board and initiates the final activity. (This activity will continue for approximately 3 - 4 minutes. Total time for instructional lesson--approximately 15 minutes.)

Upon completion of the lesson, the E tells the Ss that they did a good job, and would they please go and stand by their desks. The E will ask the Ss to stretch -- see if you can touch the sky. The Ss will then be asked to take their seats and pay attention.

The E then tells the Ss that he would like them to answer some questions. The E tells the Ss, as I call your name, raise your hand, and I will give you a booklet, Remember do not open it until I ask you to do so. (E distributes the booklets and a pencil to each S. The E then slowly reads the instructions to the Ss as outlined in the directions for administering the test.) When the questions are answered, the E collects the booklets from the Ss and thanks the Ss for their help. The E then returns the Ss to their classroom.

Treatment 4: Cutting Tool Lesson (Placebo)

Instructions to Students

Good morning (afternoon) boys.

My name is _____. I work at the University of Wisconsin in Madison. At the university, people are studying how children learn. You can help us in our work by answering some questions for me. I am going to give you a booklet with some questions. Please do not open the booklet until I ask you to do so. I want you to do a good job in answering the questions. By doing a good job, you can help me find out what you know. As I call your name, raise your hand, and I will give you a booklet. Remember do not open the booklet until I ask you to do so. (E distributes the booklets and a pencil to the Ss. E slowly reads the instructions to the Ss as outlined in the directions for administering the test.)

When the questions are answered, the E tells the Ss that they did a good job. The E then invites the Ss to stand up and stretch -- see if you can touch the ceiling. As the Ss are stretching, the E collects the booklets.

The E then asks the Ss to join him near a small table where a flannel board is set up. The Ss will be asked to sit on the floor in a semi-circular fashion facing the flannel board. The E tells the Ss that he is going to show the Ss some words and that the E would like the Ss to look at the words and study them.

Verbal Labels:

tools
cutting tools
hard
sharp
smooth-edge
scissors
penknife
axe

dull
blade
teeth
tooth-edge

rip saw
hack saw
two-man saw

The E presents each word individually and allows the Ss to view the words for 5 seconds. Upon completion of the aforesaid activity, the E informs the Ss that he is going to say the words out loud, and that the Ss should repeat each word out loud. Then both the E and the Ss will say the words out loud together. (E presents each word individually and initiates the activity.) Upon completion of the activity, the E tells the Ss that it would be fun to do it again, but first the E would like to mix the words up. (E shuffles the order of the word cards and repeats the previous procedure. Approximate time for completion of the above activities: 4 1/2 - 5 minutes.)

For the next activity, the E tells the Ss that the E would like to tell them about different kinds of tools. Tools are things that help us do work. (E places the appropriate verbal label word card on the flannel board and pronounces it. He then asks the Ss to repeat it. The E will verbally reinforce the Ss for their response.) The E informs the Ss that he is going to tell them about special kinds of tools -- cutting tools. (E places the appropriate verbal label word card on the flannel board and pronounces it. He then asks the Ss to also pronounce it. The E will verbally reinforce the Ss for their response.) The E then removes the two previously described verbal label word cards and places drawings of the following cutting tools on the flannel board: a scissors, an axe, a pen-knife, a two-man saw, a hack saw, and a rip saw. The E tells the Ss that these are drawings of some cutting tools. Let's say their names together. (The E points to each drawing and places the appropriate verbal label word card beneath each drawing. The E then tells the Ss the appropriate name

for each cutting tool. The E will request the Ss to pronounce the name of each drawing along with the E. The E will verbally reinforce the Ss after each drawing is named.) Upon completion of this activity, the E informs the Ss that he would like to say the names of the drawings one more time. (E repeats the procedure of saying the names of the cutting tools and of saying the names together with the Ss. The E will verbally reinforce the Ss after each drawing is named.) The E then points to each one of the drawings and asks the Ss if they can tell the E what each cutting tool is used to cut. (The E calls upon each S individually, reinforcing the S for the correct response. If an inappropriate response is given, the E will supply the correct response and ask the S to repeat the response. Approximate time for completion of the above activities: 4 minutes.)

Next, the E points to the blade of the penknife and asks the Ss if they know to what the E is pointing. (E awaits response from the Ss. If the Ss supply the correct response, i.e., the blade, the E repeats the response and verbally reinforces the Ss. If an inappropriate response is given, the E supplies the correct response and asks the Ss to repeat it.) The E tells the Ss that there are two kinds of blades, some that have teeth, (E points to the teeth of the rip saw, hack saw, and two-man saw drawings), and some that don't have teeth, (E points to the drawings of the axe, penknife, and scissors). (E places the appropriate verbal label word card on the flannel board and pronounces it. He then asks the Ss to also pronounce it. The E will verbally reinforce the Ss for their response.) The E explains to the Ss that cutting tools that have teeth are called tooth-edge cutting tools, cutting tools that don't have teeth are called smooth-edge cutting tools. (E places the appropriate verbal label word

cards on the flannel board. The E, pointing to the verbal label word card 'tooth-edge', pronounces it, and asks the Ss to repeat it twice. The E will verbally reinforce the Ss after each response. The E repeats the procedure, substituting 'smooth-edge' for 'tooth-edge'.) The E tells the Ss that because cutting tools are made from hard metal they can be kept sharp. (E places the appropriate verbal label word cards on the flannel board. The E points to the verbal label word card 'hard', pronounces it, and asks the Ss to repeat it twice. The E will verbally reinforce the Ss after each response. The E repeats the procedure, substituting 'sharp' for 'hard'.) The E then tells the Ss that when cutting tools are kept sharp they cut easily, when cutting tools are dull cutting is difficult. (The E places the appropriate verbal label word card on the flannel board. The E points to the word card and pronounces the word for the Ss. The E then asks the Ss to repeat the word twice. The E will verbally reinforce the Ss for their response. Approximate time for completion of described activities: 3 minutes.)

As a concluding activity to the instructional lesson, the E will ask the Ss to come to the flannel board one at a time, and choose a cutting tool from a stimulus array that contains examples and non-examples of cutting tools. (Non-examples include: a rake, a safety pin, a pencil, a needle, a bell, a nail, a fork, a hammer, a screwdriver, a paper clip, an arrow, a comb, and a spoon.) For example, a particular stimulus array might contain a hammer, a fork, a rake, a rip saw, and a comb. The S will be asked to choose the cutting tool, i.e., the rip saw. The Ss will also be asked to name the cutting tool and to tell if it is a smooth-edge or a tooth-edge cutting tool. Ten stimulus arrays will be presented to the Ss, therefore each S will be asked to come to the flannel board twice. (The

E will verbally reinforce the Ss for correct responses. If an inappropriate response is given, the E will supply the correct response and ask the S to repeat the response. Approximate time for completion of the above activities: 3 - 4 minutes. Total time for instructional lesson--approximately 15 minutes.)

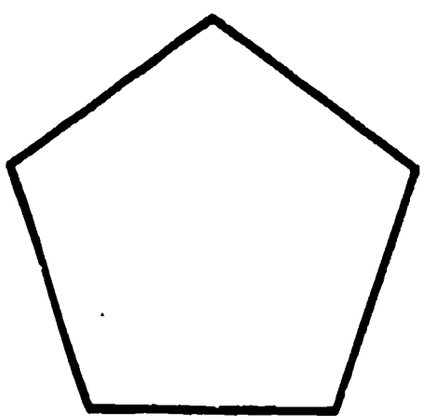
Upon completion of the lesson, the E will tell the Ss that they did a good job, and would they please go and stand by their desks. The E will then ask the Ss to stretch -- see if you can touch the sky. The Ss will then be asked to take their seats and pay attention.

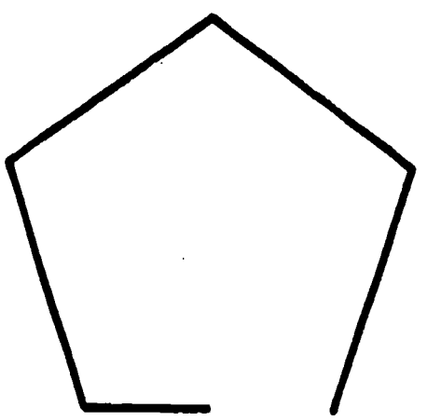
The E then informs the Ss that he would like them to answer some questions. The E tells the Ss as I call your name, raise your hand, and I will give you a booklet. Remember do not open the booklet until I ask you to do so. (E then distributes the booklets and pencils to the Ss. The E then slowly reads the instructions to the Ss as outlined in the directions for administering the test.) When the questions are answered, the E collects the booklets from the Ss and thanks the Ss for their help. The E then returns the Ss to their classroom.

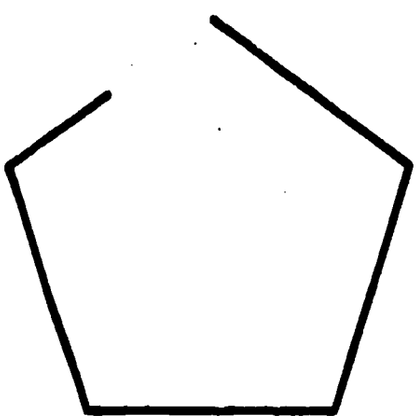
Appendix B

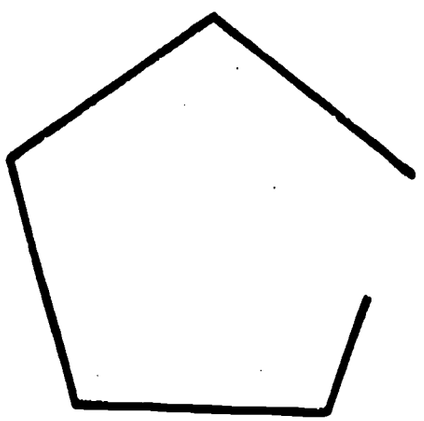
Drawings of Stimulus Materials

Drawings of Open and Closed Pentagons

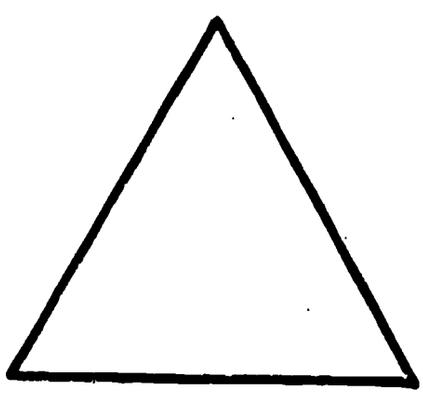


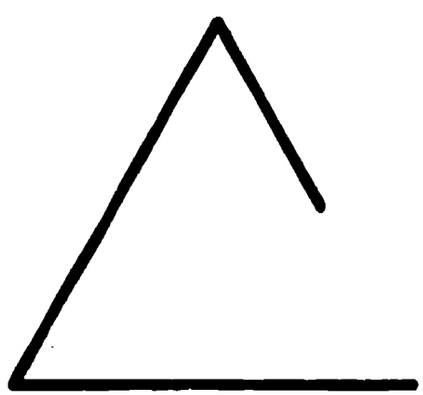


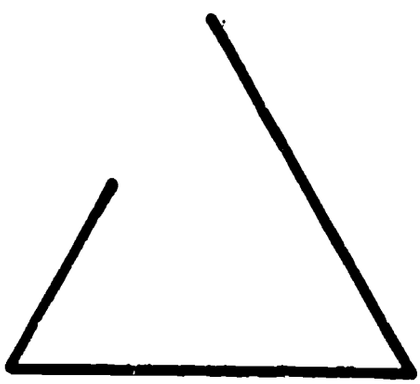


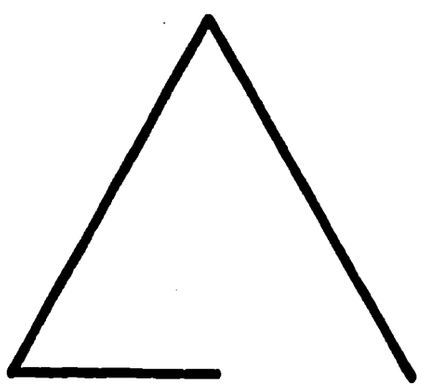


Drawings of Open and Closed Equilateral Triangles



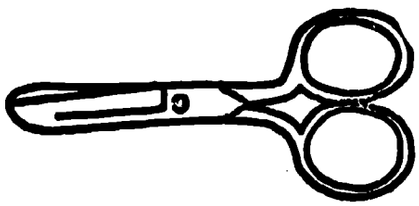


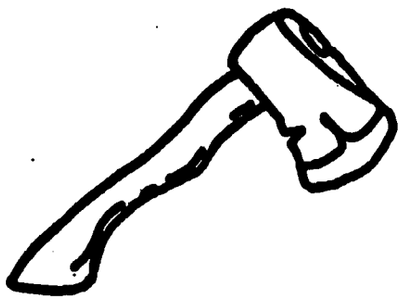




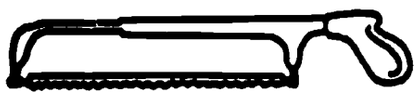
Examples of Cutting Tools

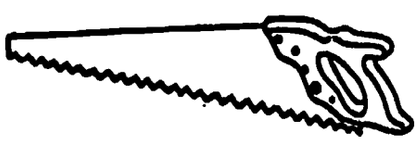
Smooth-Edge



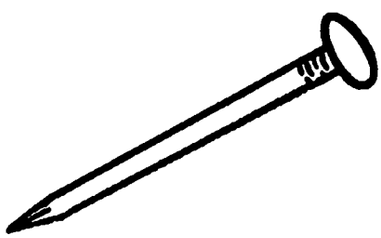


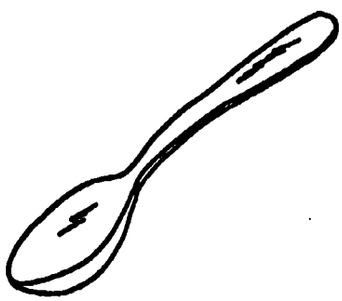
Tooth-Edge

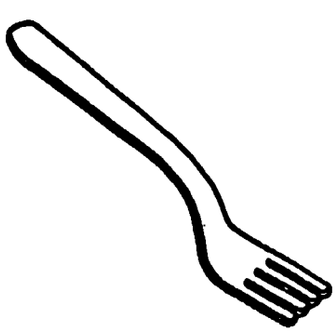


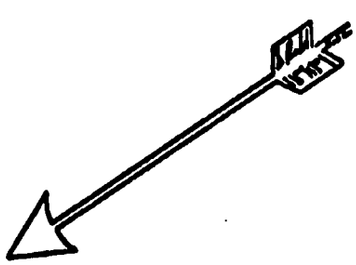


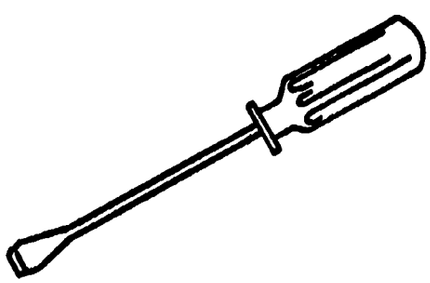
Non-Examples of Cutting Tools

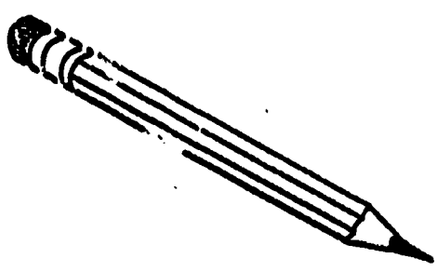




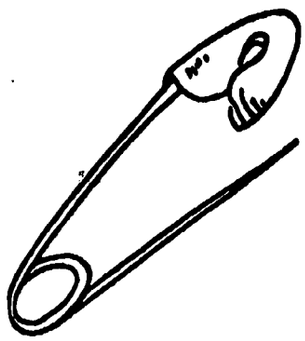


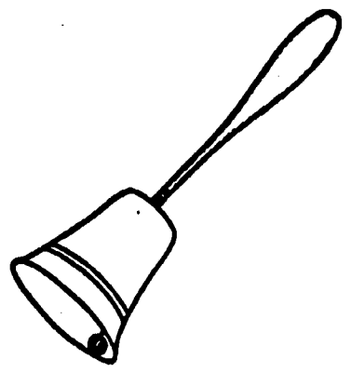


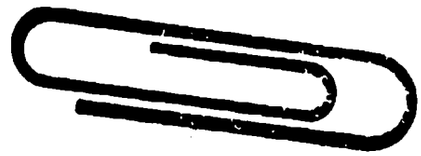


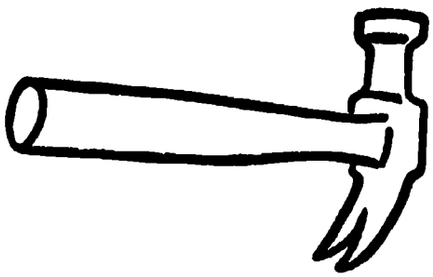


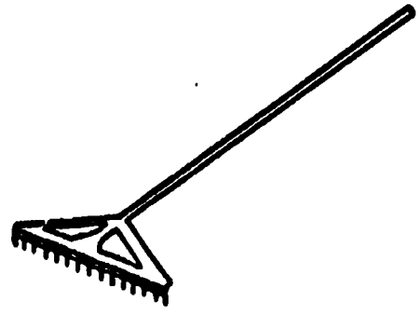
Non-Examples of Cutting Tools
(Continued)











Appendix C

Dependent Measure -- Pilot Study

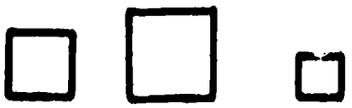
Name_____

Concept Development ID

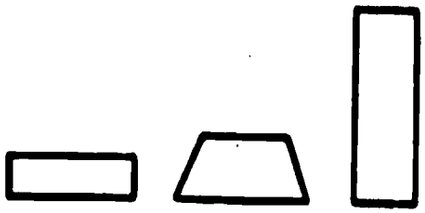
Klausmeier, H. J., Ingison, L. J., Sipple, T. S., Katzenmeyer, C. G.

Stop

1



Group 1



Group 2

What one name best fits all of the drawings in Group 1 but does not fit all of the drawings in Group 2?

a. squares

b. triangles

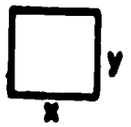
c. trapezoids

d. pentagons

e. I don't know.

Stop

2



Suppose that sides x and y are each 3 inches long. Choose the one answer which best describes how side x is like side y. Side x and side y _____.

a. are of even length.

b. are of equal length.

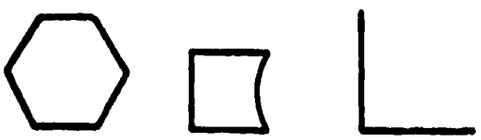
c. coincide in length.

d. I don't know.

Stop

3

Group 1



Group 2

Which one name best fits all of the drawings in Group 1 but does not fit all of the drawings in Group 2?

a. squares

b. trapezoids

c. triangles

d. rectangles

e. I don't know.

Stop

4

Group 1

Group 2

Which one name best fits all of the drawings in Group 1 but does not fit all of the drawings in Group 2?

a. pentagons

b. rectangles

c. triangles

d. squares

e. I don't know.

Stop

5

What is the one word that best indicates what the arrow is pointing at?

a. angle

b. line

c. side

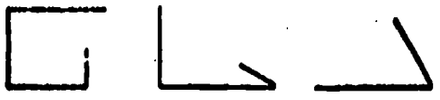
d. base

e. I don't know.

Stop

6

Group 1



Group 2

Which one name best fits all of the drawings in Group 1 but does not fit all of the drawings in Group 2?

a. symmetrical figures

b. closed figures

c. regular figures

d. I don't know.

Stop

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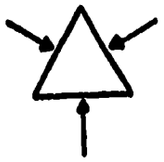
7



What is the one word that best indicates what each arrow is pointing to?

a. angle

b. vertex

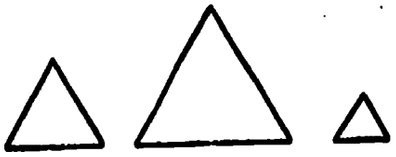
c. side

d. straight edge

e. I don't know.

Stop

8



Group 1

Group 2

Which one name best fits all of the drawings in Group 1 but does not fit all of the drawings in Group 2?

a. scalene triangles

b. right triangles

c. obtuse triangles

d. equilateral triangles

e. I don't know.

Stop

9

Group 1

Group 2

Which one name best fits all of the drawings in Group 1 but does not fit all of the drawings in Group 2?

a. symmetrical figures

b. simple figures

c. regular figures

d. I don't know.

Stop

10

Which one name is best for the distance around each of the figures?

a. diameter

b. perimeter

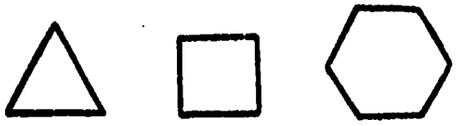
c. radius

d. area

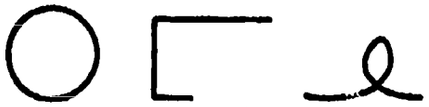
e. I don't know.

Stop

11



Group 1



Group 2

Which one answer best fits all of the drawings in Group 1 but does not fit all of the drawings in Group 2?

a. They are similar figures.

b. They are polygons.

c. They are complex forms.

d. They are open figures.

e. I don't know.

12

Group 1

Group 2

Which one name best fits all of the drawings in Group 1 but does not fit all of the drawings in Group 2?

a. isosceles triangles

b. equilateral triangles

c. obtuse triangles

d. right triangles

e. I don't know.

Stop

Group 1

Group 2

Which one name best fits all of the drawings in Group 1 but does not fit all of the drawings in Group 2?

a. parallelograms

b. quadrilaterals

c. triangles

d. rectangles

e. I don't know.

Stop

Appendix D

Instructional Lessons

Main Study

Treatment 1: Lesson on Geometric Figures

Instructions to Students

Good morning (afternoon) boys.

My name is _____. I work at the University of Wisconsin in Madison. At the university, people are studying how children learn. You can help us in our work by answering some questions for me. In a little while, I am going to give you a booklet with some questions. I want you to do a good job in answering the questions. By doing a good job you can help me find out what you know. First though, I want to talk to you about something very interesting.

The E then asks the Ss to join him near a small table where a flannel board is set up. The Ss will be asked to sit on the floor in a semi-circular fashion facing the flannel board. The E tells the Ss that he is going to show the Ss some words and that the E would like the Ss to look at the words and study them.

Verbal Labels:

polygons	equal
pentagon	shape
regular pentagon	perimeter
five	simple figures
sides	open figure
angle	closed figure

The E presents each word individually and allows the Ss to view the words for 5 seconds. Upon completion of the aforesaid activity, the E informs the Ss that he is going to say the words out loud, and that the Ss should repeat each word out loud. Then both the E and the Ss will say the words out loud together. (E presents each word individually and initiates the activity.) Upon completion of the activity, the E tells the Ss that it

would be fun to do it again, but first the E would like to mix the words up. (E shuffles the order of the word cards and repeats the previous procedure. Approximate time for completion of the above activities: 5 minutes.)

After the introduction of the verbal labels, the E provides information about the characteristics of a pentagon. The E tells the Ss that he would like to talk to them about a very special kind of pentagon. (E places the appropriate verbal label word card on the flannel board, pronounces it, and asks the Ss to repeat it twice. The E will verbally reinforce the Ss after each response.) The E tells the Ss that the special kind of pentagon we are going to talk about is called a regular pentagon. (E places a large regular pentagon [each side 3 13/16 inches] on the flannel board. Beneath the pentagon, the E places the appropriate verbal label word card. The E pronounces the word, asking the Ss to repeat 'regular pentagon' twice. The E will verbally reinforce the Ss after each pronunciation.) Next, the E points to the sides of the pentagon one at a time, and asks the Ss if they know to what the E is pointing. (E awaits response from the Ss. If the Ss supply the correct response, i.e., the sides, the E will verbally reinforce the Ss and repeat the response, placing the appropriate verbal label word card on the flannel board. If an inappropriate response is given, the E supplies the correct response and asks the Ss to repeat the response.) The E then tells the Ss that a pentagon has five sides, and this pentagon has all of the sides the same length, or we can say that the sides of this pentagon are equal. (E says 'five' and 'equal' as he places the appropriate verbal label word cards on the flannel board, asking the Ss to repeat each word. The E will verbally reinforce the Ss after each response. The E then counts the sides

of the pentagon, pointing to each side. The E also shows the Ss that the sides of the pentagon are of the same length.) The E then explains to the Ss that when the sides of a pentagon come together, the sides form an angle. (The E places the appropriate verbal label word card on the flannel board and pronounces the word as he points to the angles of the pentagon. The E asks the Ss to repeat the word, verbally reinforcing the Ss for their response.) Next, the E asks the Ss how many angles does a pentagon have? (E awaits response from the Ss. If the Ss supply the correct response, i.e., five angles, the E will verbally reinforce the Ss and repeat the response. If an inappropriate response is given, the E supplies the correct response and asks the Ss to repeat the response.) The E then places a small regular pentagon (each side 1 11/32 inches) and a medium-size regular pentagon (each side 2 9/16 inches) of different colors on the flannel board. The E explains to the Ss that even though these pentagons are of different sizes and colors they still look alike, or we can say they have the same shape. (E places the appropriate verbal label word card on the flannel board and pronounces the word for the Ss, asking the Ss to repeat it. The E will verbally reinforce the Ss for their response. Approximate time for completion of the above activities: 4 minutes.)

For the next activity, the E places the three previously described pentagons in various positions, i.e., one pentagon pointing to the left, another pointing to the right and the third pentagon pointing "up-side down". The E explains to the Ss that it doesn't make any difference what position the pentagons are in, they still remain pentagons. The E then places the pentagons in still other positions and asks the Ss if the pentagons still remain pentagons. (E awaits response from the Ss. If the Ss supply the correct response, the E will verbally reinforce the Ss.

If an inappropriate response is given, the E will repeat the previous explanation.) Pointing to the pentagons, the E informs the Ss that pentagons are kinds of polygons. (E places the appropriate verbal label word card on the flannel board and pronounces the word, asking the Ss to repeat it. The E will verbally reinforce the Ss for their response.) The E tells the Ss that the has another word for the Ss to say. The E says perimeter and asks the Ss to repeat it. (E places the appropriate verbal label word card on the flannel board, points to it, and says 'perimeter', asking the Ss to repeat it again. The E will verbally reinforce the Ss for their response.) The E explains to the Ss that the distance around a pentagon is called its perimeter. The E will explain to the Ss that if each side of a regular pentagon is one inch long, and a pentagon has five sides, then the perimeter or distance around the pentagon will be five inches. (Approximate time for completion of described activities: 3 minutes.)

As a concluding activity to the instructional lesson, the E will point to the pentagons and tell the Ss that besides being kinds of polygons, pentagons are also kinds of simple figures. (The E will ask the Ss to say the word 'simple figures'. E then places the appropriate verbal label word card on the flannel board, pronounces it, and asks the Ss to say the word once again. The E will verbally reinforce the Ss for their response.) The E removes the pentagons and places a 4 x 6 inch file card on the flannel board containing a line drawing of a regular pentagon (each side 1 1/2 inches). The E explains to the Ss that the drawing is a closed figure, that is, the ends of the sides touch each other forming angles. (The E will ask the Ss to say the word 'closed figure'. E then places the appropriate verbal label word card on the flannel board, pronounces it,

it, and asks the Ss to say the word once again. The E will verbally reinforce the Ss for their response.) When some of the sides don't touch each other we have an open figure. (The E will ask the Ss to say the word 'open figure'. E then places the appropriate verbal label word card on the flannel board, pronounces it, and asks the Ss to say the word once again. The E will verbally reinforce the Ss for their response.) The E then places three 4 x 6 inch file cards on the flannel board one at a time, each one showing an incomplete pentagon--one that has one of its sides incomplete (each complete side 1 1/2 inches). The E points to the open side explaining to the Ss that this is why the drawing is called an open figure. To complete the final segment of the instructional lesson, the E will ask the Ss, as a group, the following questions:

1. How many sides does a pentagon have?
2. How many angles does a pentagon have?
3. When pentagons look alike, we say they have the same _____.
4. The distance around a pentagon is called its _____.

(If the Ss give the correct response, the E will verbally reinforce the Ss and repeat the response. If an inappropriate response is given, the E will supply the correct response and ask the Ss to repeat the response. Approximate time for completion of the above activities: 4 minutes. Total time for instructional lesson--approximately 16 minutes.)

Upon completion of the lesson, the E will tell the Ss that they did a good job, and would they please go and stand by their desks. The E will then ask the Ss to stretch -- see if you can touch the sky. The Ss will then be asked to take their seats and pay attention.

The E then tells the Ss that he would like them to answer some questions. The E tells the Ss, as I call your name, raise your hand, and I

will give you a booklet. Remember do not open it until I ask you to do so. (E distributes the booklets and a pencil to each S. The E then slowly reads the instructions to the Ss as outlined in the directions for administering the test.) When the questions are answered, the E collects the booklets from the Ss and thanks the Ss for their help. The E then returns the Ss to their classrooms.

Treatment 2: Lesson on Equilateral Triangles

Instructions to Students

Good morning (afternoon) boys.

My name is _____. I work at the University of Wisconsin in Madison. At the university, people are studying how children learn. You can help us in our work by answering some questions for me. In a little while I am going to give you a booklet with some questions. I want you to do a good job in answering the questions. By doing a good job you can help me find out what you know. First though, I want to talk to you about something very interesting.

The E then asks the Ss to join him near a small table where a flannel board is set up. The Ss will be asked to sit on the floor in a semi-circular fashion facing the flannel board. The E tells the Ss that he is going to show the Ss some words and that the E would like the Ss to look at the words and study them.

Verbal Labels:

polygons
triangle
equilateral triangle
three
sides
angle
equal
shape
perimeter
simple figures
open figure
closed figure

The E presents each word individually and allows the Ss to view the words for 5 seconds. Upon completion of the aforesaid activity, the E informs the Ss that he is going to say the words out loud, and that the Ss should repeat each word out loud. Then both the E and the Ss will say the words out loud together. (E presents each word individually and initiates the activity.) Upon completion of the activity, the E tells

the Ss that it would be fun to do it again, but first the E would like to mix up the words. (E shuffles the order of the word cards and repeats the previous procedure. Approximate time for completion of the above activities: 5 minutes.)

After the introduction of the verbal labels, the E provides information about the characteristics of the equilateral triangle. The E places a large equilateral triangle (6 x 6 x 6 inch) on the flannel board. The E asks the Ss if they can tell the E what the shape is called. (E awaits response from the Ss. If the Ss supply the correct response, i.e., a triangle, the E will verbally reinforce the Ss and repeat the response, placing the appropriate verbal label word card on the flannel board. If an inappropriate response is given, the E supplies the correct response and asks the Ss to repeat the response.) The E then tells the Ss that this is a special kind of triangle, it is an equilateral triangle. (E places the appropriate verbal label word card on the flannel board and asks the Ss to say 'equilateral triangle' twice. The E will reinforce the Ss after each pronunciation.) Next, the E points to the sides of the equilateral triangle one at a time, and asks the Ss if they know to what the E is pointing. (E awaits response from the Ss. If the Ss supply the correct response, i.e., the sides, the E will verbally reinforce the Ss and repeat the response, placing the appropriate verbal label word card on the flannel board. If an inappropriate response is given, the E supplies the correct response and asks the Ss to repeat the response.) The E tells the Ss that an equilateral triangle has three sides, and that all of the sides are of the same length, or we can say that the sides of an equilateral triangle are equal. (E says 'three' and 'equal' as he places the appropriate verbal label word

cards on the flannel board, asking the Ss to repeat each word. The E will verbally reinforce the Ss after each response. The E then counts the sides of the triangle, pointing to each side. The E also shows the Ss that the sides of the triangle are of the same length.) The E then explains to the Ss that when the sides of a triangle come together the sides form an angle. (The E places the appropriate verbal label word card on the flannel board and pronounces the word as he points to the angles of the triangle. The E asks the Ss to repeat the word, verbally reinforcing the Ss for their response.) Next, the E asks the Ss how many angles does a triangle have? (E awaits response from the Ss. If the Ss supply the correct response, i.e., three angles, the E will verbally reinforce the Ss and repeat the response. If an inappropriate response is given, the E will supply the correct response, and ask the Ss to repeat the response.) The E then places a small (2 x 2 x 2 inch) equilateral triangle and a medium-size (4 x 4 x 4 inch) equilateral triangle of different colors on the flannel board. The E explains to the Ss that even though the equilateral triangles are of different sizes and colors they still look alike, or we can say they have the same shape. (E places the appropriate verbal label word card on the flannel board and pronounces the word for the Ss, asking the Ss to repeat it. The E will verbally reinforce the Ss for their response. Approximate time for completion of the above activities: 4 minutes.)

For the next activity, the E places the three previously described equilateral triangles in various positions, i.e., one pointing to the left, another pointing to the right and the third triangle pointing "up-side down". The E explains to the Ss that it doesn't make any difference what position the equilateral triangles are in, they still remain equilateral

triangles. The E then places the equilateral triangles in still other positions and asks the Ss if they still remain equilateral triangles. (E awaits response from the Ss. If the Ss supply the correct response, the E will verbally reinforce the Ss. If an inappropriate response is given, the E will repeat the previous explanation.) Pointing to the triangles, the E informs the Ss that equilateral triangles are kinds of polygons. (E places the appropriate verbal label word card on the flannel board and pronounces the word, asking the Ss to repeat it. The E will verbally reinforce the Ss for their response.) The E then tells the Ss that he has another word for the Ss to say. The E says perimeter and asks the Ss to repeat it. (E places the appropriate verbal label word card on the flannel board, points to it, and says 'perimeter', asking the Ss to repeat it again. The E will verbally reinforce the Ss for their response.) The E explains to the Ss that the distance around an equilateral triangle is called its perimeter. The E will explain to the Ss that if each side of an equilateral triangle is one inch long, and an equilateral triangle has three sides, then the perimeter or distance around the equilateral triangle will be three inches. (Approximate time for completion of described activities: 3 minutes.)

As a concluding activity to the instructional lesson, the E will point to the equilateral triangles and tell the Ss that besides being kinds of polygons, equilateral triangles are also kinds of simple figures. (The E will ask the Ss to say the word 'simple figure'. E then places the appropriate verbal label word card on the flannel board, pronounces it, and asks the Ss to say the word once again. The E will verbally reinforce the Ss for their response.) The E removes the equilateral triangles and places a 3 x 5 inch file card on the flannel board containing a line

drawing of an equilateral triangle (each side 2 inches). The E explains to the Ss that the drawing is a closed figure, that is, the ends of the sides touch each other forming angles. (The E will ask the Ss to say the word 'closed figure'. E then places the appropriate verbal label word card on the flannel board, pronounces it, and asks the Ss to say the word once again. The E will verbally reinforce the Ss for their response.) When some of the sides don't touch each other we have an open figure. (The E will ask the Ss to say the word 'open figure'. E then places the appropriate verbal label word card on the flannel board, pronounces it, and asks the Ss to say the word once again. The E will verbally reinforce the Ss for their response.) The E then places three 3 x 5 inch file cards on the flannel board one at a time, each one showing an incomplete equilateral triangle--one that has one of its sides incomplete (each complete side 2 inches). The E points to the open side explaining to the Ss that this is why the drawing is called an open figure. To complete the final segment of the instructional lesson, the E will ask the Ss, as a group, the following questions:

1. How many sides does an equilateral triangle have?
2. What is special about the sides of an equilateral triangle?
3. How many angles does an equilateral triangle have?
4. When equilateral triangles look alike we say they have the same _____?
5. The distance around an equilateral triangle is called its _____.

(If the Ss give the correct response, the E will verbally reinforce the Ss and repeat the response. If an inappropriate response is given, the E will supply the correct response and ask the Ss to repeat the response. Approximate time for completion of the above activities: 4 minutes.

Total time for instructional lesson--approximately 16 minutes.)

Upon completion of the lesson, the E will tell the Ss that they did a good job, and would they please go and stand by their desks. The E will ask the Ss to stretch -- see if you can touch the sky. The Ss will then be asked to take their seats and pay attention.

The E then tells the Ss that he would like them to answer some questions. The E tells the Ss as I call your name, raise your hand, and I will give you a booklet. Remember do not open it until I ask you to do so. (E distributes the booklets and a pencil to each S. The E then slowly reads the instructions to the Ss as outlined in the directions for administering the test.) When the questions are answered, the E collects the booklets from the Ss and thanks the Ss for their help. The E then returns the Ss to their classroom.

Treatment 3: Labeling Lesson

Instructions to Students

Good morning (afternoon) boys.

My name is _____. I work at the University of Wisconsin in Madison. At the university, people are studying how children learn. You can help us in our work by answering some questions for me. In a little while I am going to give you a booklet with some questions. I want you to do a gbod job in answering the questions. By doing a good job you can help me find out what you know. First though, I want to talk to you about something very interesting.

The E then asks the Ss to join him near a small table where a flannel board is set up. The Ss will be asked to sit on the floor in a semi-circular fashion facing the flannel board. The E tells the Ss that he is going to show the Ss some words and that the E would like the S: to look at the words and study them.

Verbal Labels:

polygon
pentagon
regular pentagon
triangle
equilateral triangle
five
three
sides
angle
equal
shape
perimeter
simple figures
open figure
closed figure

The E presents each word individually and allows the Ss to view the words for 5 seconds. Upon completion of the aforesaid activity, the E informs the Ss that he is going to say each word out loud, and that the Ss should repeat each word out loud. Then both the E and the Ss will say the words out loud together. (E presents each word individually and initiates the

activity.) Upon completion of the activity, the E tells the Ss that it would be fun to do it again, but first the E would like to mix the words up. (E shuffles the order of the word cards and repeats the previous procedure. Approximate time for completion of the above activities: 5 minutes.)

Next, the E places each word card on the flannel board. The E points to the word card and pronounces the word out loud. The E then invites the Ss to come to the flannel board one at a time. The S will be requested to pronounce the word out loud while pointing to the word card. (If the S correctly completes the activity, the E will verbally reinforce the S. If an inappropriate response is given, the E will point to the word and say it. The S will then be asked to repeat the word.) All Ss will be called upon until the entire list of verbal labels is presented twice. (Approximate time for completion of the above activities: 4 minutes.)

The E then tells the Ss that he thinks it would be fun to say the words together one more time. The E shows the Ss the word cards one at a time and says each word out loud. The Ss are requested to repeat the words out loud. Then the E and Ss say the words out loud together. (E shows the Ss the first word card and begins the activity.) When the list is completed once, the E tells the Ss that he would like to do it again, but first the cards must be mixed up. (E shuffles the cards, and once again initiates the activity. Approximate time for completion of described activities: 3 minutes.)

The E then tells the Ss that they are doing a good job, and that the E is very proud of them. To assure the continuance of the Ss' attention the E places a word card on the flannel board and asks one of the Ss if

he can tell the E what it says. (If the S gives a correct response the E will verbally reinforce the S and give the S the word card to hold. If an incorrect response is given, the E will say the word and ask the S to repeat it. The E then places the card back in the pile.) The E will choose both those Ss who volunteer and those Ss who do not. The E places a second word card on the flannel board and initiates the final activity. (This activity will continue for approximately 4 minutes. Total time for instructional lesson--approximately 16 minutes.)

Upon completion of the lesson, the E tells the Ss that they did a good job, and would they please go and stand by their desks. The E will then ask the Ss to stretch -- see if you can touch the sky. The Ss will then be asked to take their seats and pay attention.

The E then tells the Ss that he would like them to answer some questions. The E tells the Ss as I call your name, raise your hand, and I will give you a booklet. Remember do not open it until I ask you to do so. (The E distributes the booklets and a pencil to each S. The E then slowly reads the instructions to the Ss as outlined in the directions for administering the test.) When the questions are answered, the E collects the booklets from the Ss, and thanks the Ss for their help. The E then returns the Ss to their classroom.

Treatment 4: Cutting Tool Lesson (Placebo)

Instructions to Students

Good morning (afternoon) boys.

My name is _____. I work at the University of Wisconsin in Madison. At the university, people are studying how children learn. You can help us in our work by answering some questions for me. In a little while I am going to give you a booklet with some questions. I want you to do a good job in answering the questions. By doing a good job you can help me find out what you know. First though, I want to talk to you about something very interesting.

The E then asks the Ss to join him near a small table where a flannel board is set up. The Ss will be asked to sit on the floor in a semi-circular fashion facing the flannel board. The E tells the Ss that he is going to show the Ss some words and that the E would like the Ss to look at the words and study them.

Verbal Labels:

tools
cutting tools
hard
sharp
dull
blade
teeth
tooth-edge
smooth-edge
scissors
penknife
axe
rip saw
hack saw
two-man saw

The E presents each word individually and allows the Ss to view the words for 5 seconds. Upon completion of the aforesaid activity, the E informs the Ss that he is going to say the words out loud, and that the Ss should repeat each word out loud. Then both the E and the Ss will say the words out loud together. (E presents each word individually and initiates the

activity.) Upon completion of the activity, the E tells the Ss that it would be fun to do it again, but first the E would like to mix the words up. (E shuffles the order of the word cards and repeats the previous procedure. Approximate time for completion of the above activities: 5 minutes.)

For the next activity, the E tells the Ss that the E would like to tell them about different kinds of tools. Tools are things that help us do work. (E places the appropriate verbal label word card on the flannel board and pronounces it. He then asks the Ss to repeat it. The E will verbally reinforce the Ss for their response.) The E informs the Ss that he is going to tell them about special kinds of tools -- cutting tools. (E places the appropriate verbal label word card on the flannel board and pronounces it. He then asks the Ss to also pronounce it. The E will verbally reinforce the Ss for their response.) The E then removes the two previously described verbal label word cards and places drawings of the following cutting tools on the flannel board: a scissors, an axe, a penknife, a two-man saw, a hack saw, and a rip saw. The E tells the Ss that these are drawings of some cutting tools. Let's say their names together. (The E points to each drawing and places the appropriate verbal label word card beneath each drawing. The E then tells the Ss the appropriate name for each cutting tool. The E will request the Ss to pronounce the name of each drawing along with the E. The E will verbally reinforce the Ss after each drawing is named.) Upon completion of this activity, the E informs the Ss that he would like to say the names of the drawings one more time. (E repeats the procedure of saying the names of the cutting tools and of saying the names together with the Ss. The E will verbally reinforce the Ss after each drawing is named.) The E then points to each

one of the drawings and asks the Ss if they can tell the E what each cutting tool is used to cut. (The E calls upon each S individually, reinforcing the S for the correct response. If an inappropriate response is given, the E will supply the correct response and ask the S to repeat the response. Approximate time for completion of the above activities: 4 minutes.)

Next, the E points to the blade of the penknife and asks the Ss if they know to what the E is pointing. (E awaits response from the Ss. If the Ss supply the correct response, i.e., the blade, the E repeats the response and verbally reinforces the Ss. If an inappropriate response is given, the E supplies the correct response and asks the Ss to repeat it.) The E tells the Ss that there are two kinds of blades, some that have teeth, (E points to the teeth of the rip saw, hack saw, and two-man saw drawings), and some that don't have teeth, (E points to the drawings of the axe, penknife, and scissors). (E places the appropriate verbal label word card on the flannel board and pronounces it. He then asks the Ss to also pronounce it. The E will verbally reinforce the Ss for their response.) The E explains to the Ss that cutting tools that have teeth are called tooth-edge cutting tools, cutting tools that don't have teeth are called smooth-edge cutting tools. (E places the appropriate verbal label word cards on the flannel board. The E, pointing to the verbal label word card 'tooth-edge', pronounces it and asks the Ss to repeat it twice. The E will reinforce the Ss after each response. The E repeats the procedure, substituting 'smooth-edge' for 'tooth-edge'.) The E tells the Ss that because cutting tools are made from hard metal they can be kept sharp. (E puts the appropriate verbal label word cards on the flannel board. The E points to the verbal label word card 'hard', pronounces it, and asks

the Ss to repeat it twice. The E will reinforce the Ss after each response. The E repeats the procedure, substituting 'sharp' for 'hard'.) The E then tells the Ss that when cutting tools are kept sharp they cut easily, when cutting tools are dull cutting is difficult. (The E places the appropriate verbal label word card on the flannel board. The E points to the word card and pronounces the word for the Ss. The E then asks the Ss to repeat the word twice. The E will verbally reinforce the Ss for their response. Approximate time for completion of described activities: 3 minutes.)

As a concluding activity to the instructional lesson, the E will ask the Ss to come to the flannel board one at a time, and choose a cutting tool from a stimulus array that contains examples and non-examples of cutting tools. (Non-examples include: a rake, a safety pin, a pencil, a needle, a bell, a nail, a fork, a hammer, a screwdriver, a paper clip, an arrow, a comb, and a spoon.) For example, a particular stimulus array might contain a hammer, a fork, a rake, a rip saw and a comb. The S will be asked to choose the cutting tool, i.e., the rip saw. The S will also be asked to name the cutting tool and to tell if it is a smooth-edge or a tooth-edge cutting tool. Five stimulus arrays will be presented to the Ss. (The E will verbally reinforce the Ss for correct responses. If an inappropriate response is given, the E will supply the correct response and ask the S to repeat the response. Approximate time for completion of the above activities: 4 minutes. Total time for instructional lesson--approximately 16 minutes.)

Upon completion of the lesson, the E will tell the Ss that they did a good job, and would they please go and stand by their desks. The E will then ask the Ss to stretch -- see if you can touch the sky. The Ss

will then be asked to take their seats and pay attention.

The E informs the Ss that he would like them to answer some questions. The E tells the Ss as I call your name, raise your hand, and I will give you a booklet. Remember do not open it until I ask you to do so. (E distributes the booklets and a pencil to each S. The E then slowly reads the instructions to the Ss as outlined in the directions for administering the test.) When the questions are answered, the E collects the booklets from the Ss and thanks the Ss for their help. The E then returns the Ss to their classroom.

Appendix E

Assessment Battery -- Main Study

Name_____ Birthdate_____
Last First Middle Month Day Year

School_____ Grade_____ Today's Date_____

Concept Development IA

Klausmeier, H.J., Ingison, L.J., Sipple, T.S., and Katzenmeyer, C.G.

DO NOT TURN THE PAGE UNTIL YOU ARE TOLD TO DO SO.

Color Key

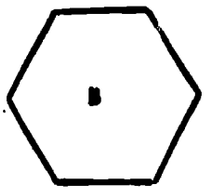
B = Blue

R = Red

Y = Yellow

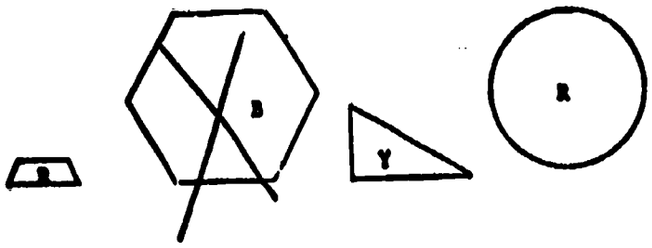
PRACTICE TRIALS

A.



Stop

A.



Stop

B.

Stop

B.

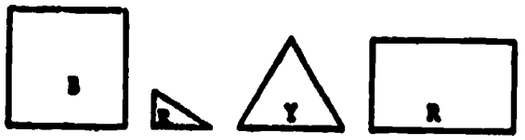
Stop

CONCRETE LEVEL

1.a

Stop

1.b

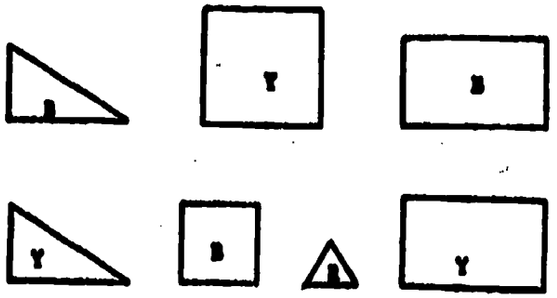


Stop

2.a

Stop

2.b

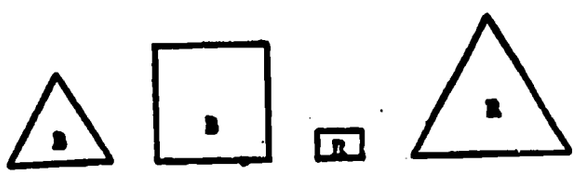


Stop

3.a

Stop

3.b

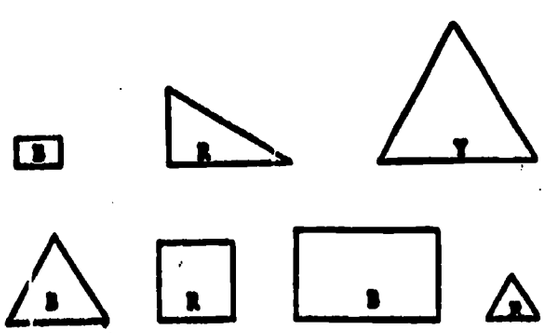


Stop

4.a

Stop

4.b



Stop

5.a

Stop

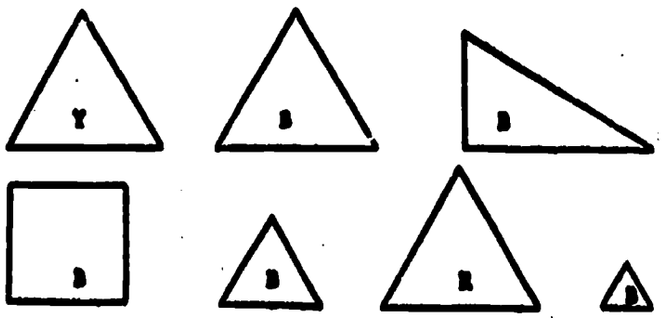
5.b

Stop

6.a

Stop

6.b

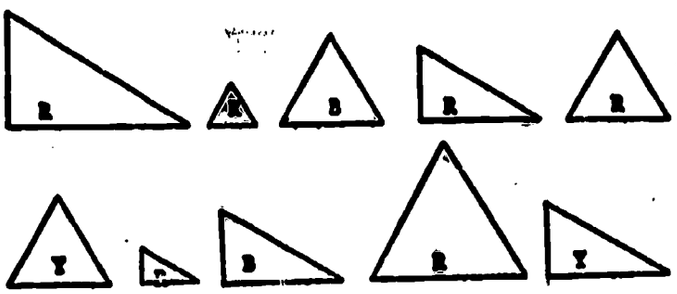


Stop

7.a

Stop

7.b

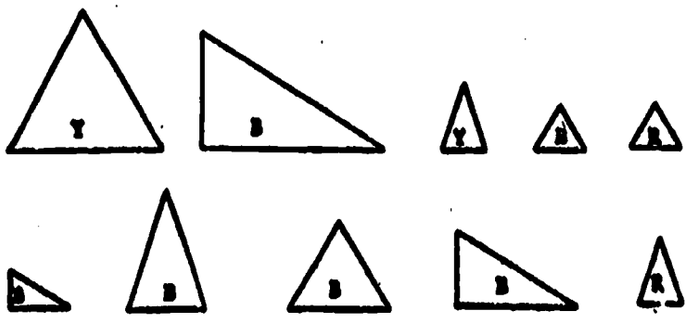


Stop

8.a

Stop

8.b



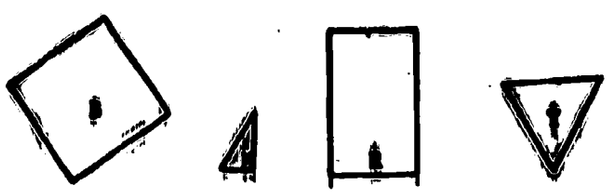
Stop

IDENTITY LEVEL

9.a

Stop

9.b

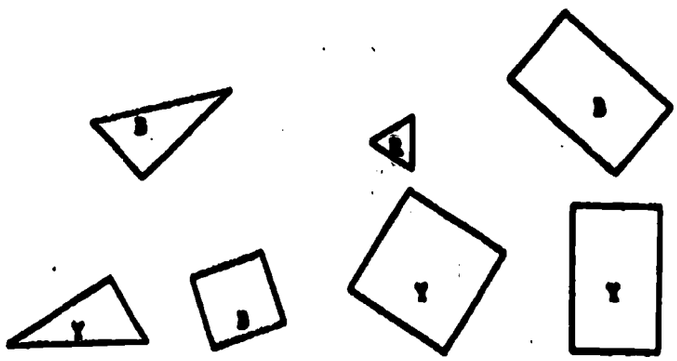


Stop

10.a

Stop

10.b

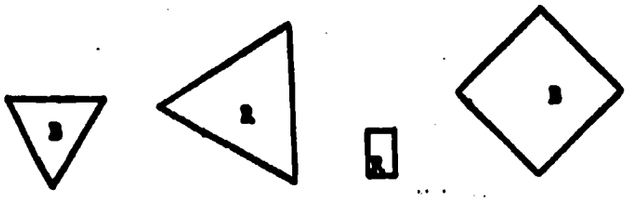


Stop

11.a

Stop

11.b

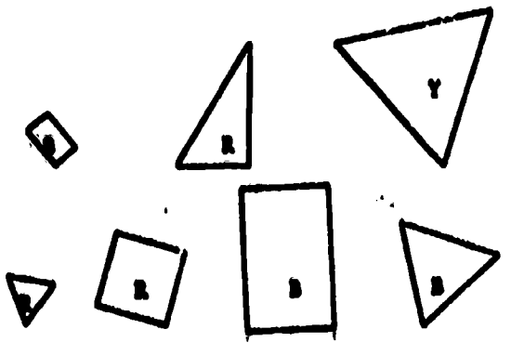


Stop

12.a

Stop

12.b

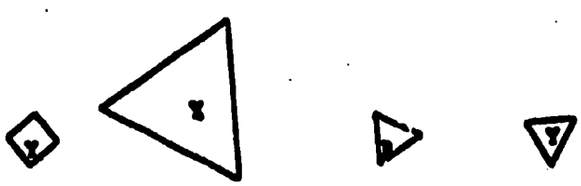


Stop

13.a

Stop

13.b

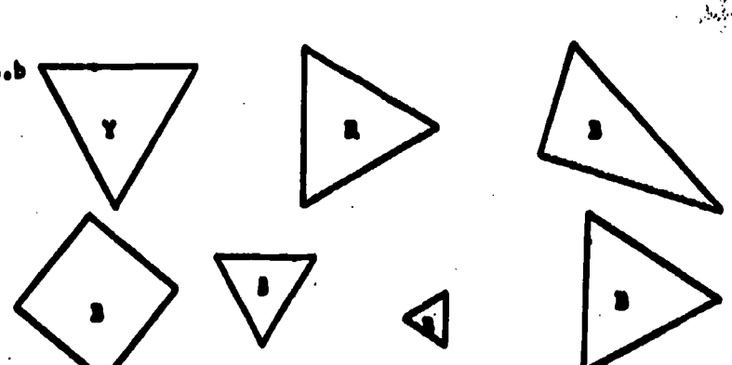


Stop

14.a

Stop

14.b

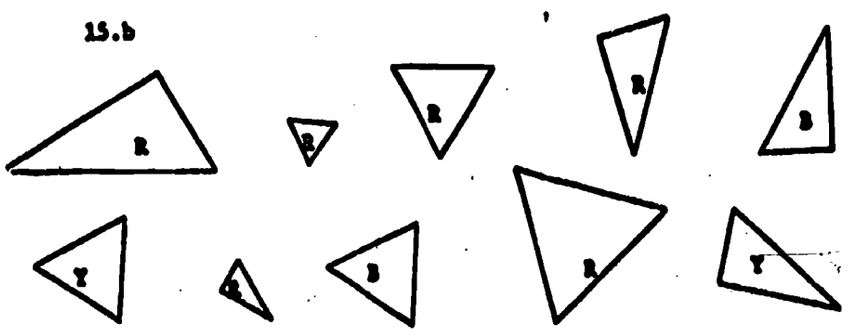


Stop

15.a

Stop

15.b

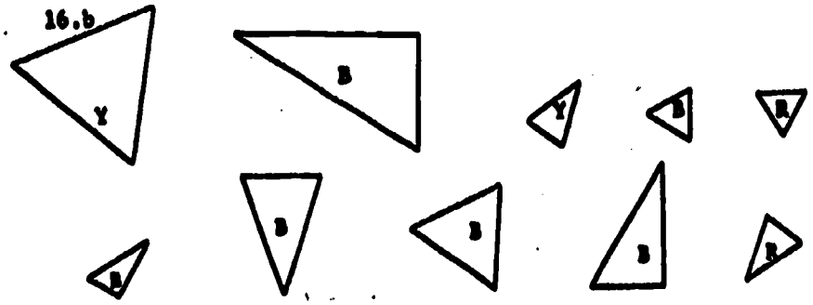


Stop

16.a

Stop

16.b



Stop

Name_____

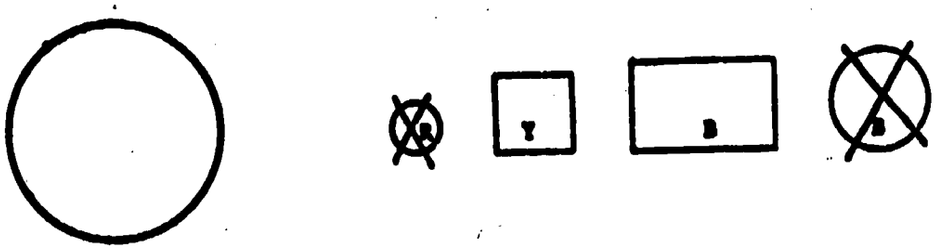
Concept Development IB

Klausmeier, H. J., Ingison, L. J., Sipple, T. S., Katzenmeyer, C. G.

Stop

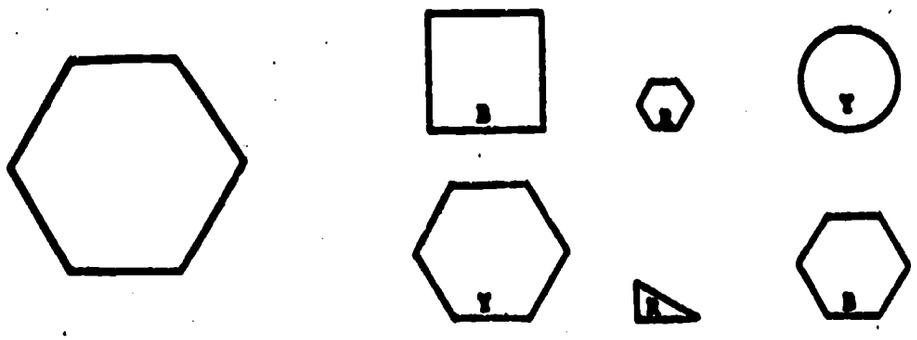
PRACTICE TRIALS

A. Put an X on the drawings on the right that have exactly the same shape as the one on the left.



Stop

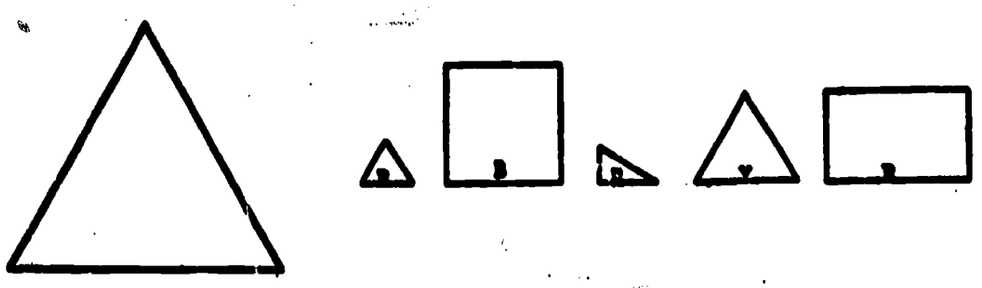
B. Put an X on the drawings on the right that have exactly the same shape as the one on the left. You can look back at the drawing on the left if you are not sure.



Stop

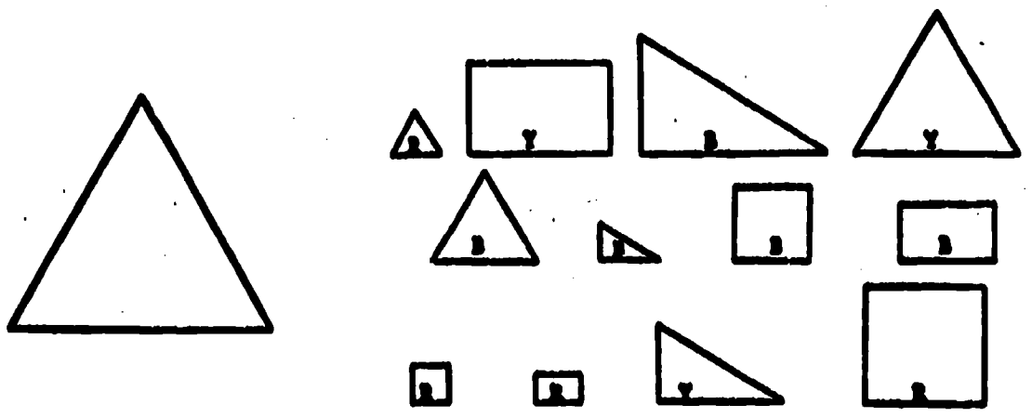
CLASSIFICATORY LEVEL

1. Put an X on the drawings on the right that have exactly the same shape as the one on the left.



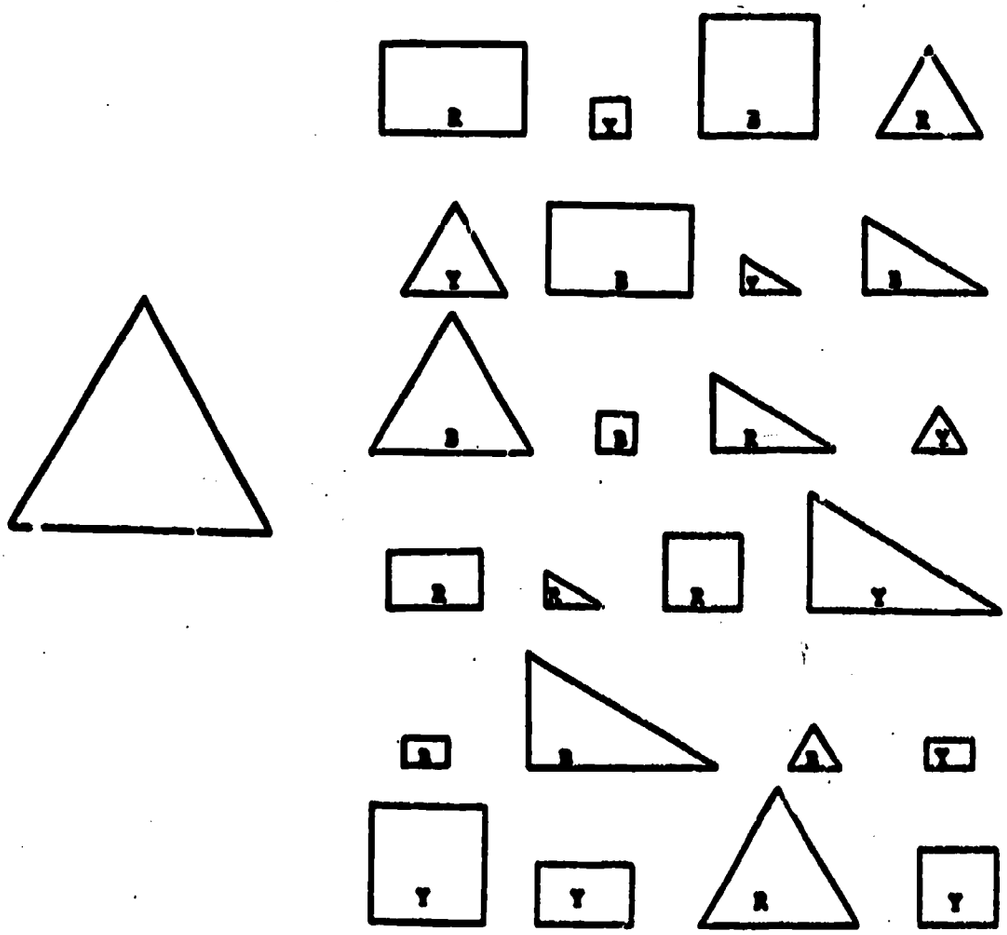
Stop

2. Put an X on the drawings on the right that have exactly the same shape as the one on the left.



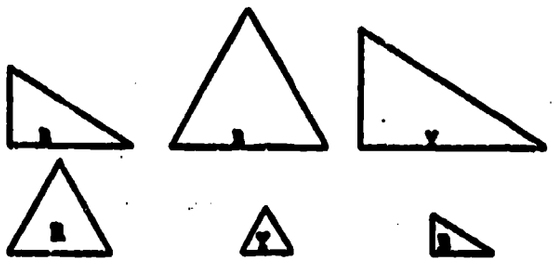
Stop

3. Put an X on the drawings on the right that have exactly the same shape as the one on the left.



Stop

SUPRAORDINATE/SUBORDINATE



4. Are all of the three-sided figures above equilateral triangles?

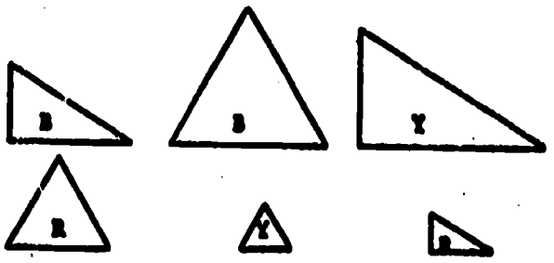
   a. Yes, all of them are equilateral triangles

   b. No, some of them are not equilateral triangles.

   c. No, none of them are equilateral triangles.

   d. I don't know.

Stop



5. Are all of the equilateral triangles above triangles?

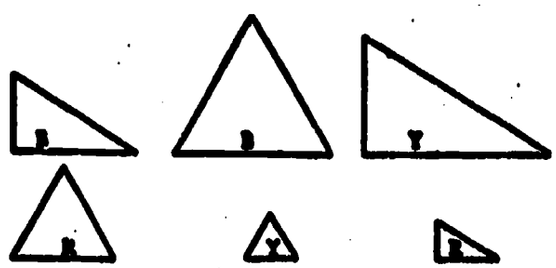
   a. No, only some of them are triangles.

   b. No, none of them are triangles.

   c. Yes, all of them are triangles.

   d. I don't know.

Stop



6. If you took all of the equilateral triangles and the right triangles above and put them in a group there would be _____ there were three-sided figures.

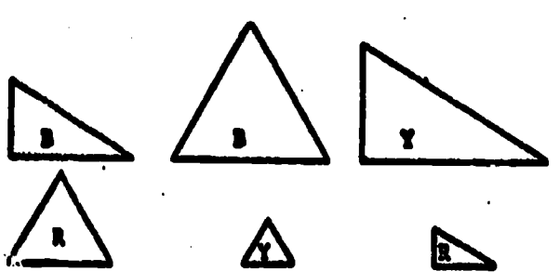
   a. fewer of them than

   b. more of them than

   c. the same amount of them as

   d. I don't know.

Stop



7. Are all of the red figures above equilateral triangles?

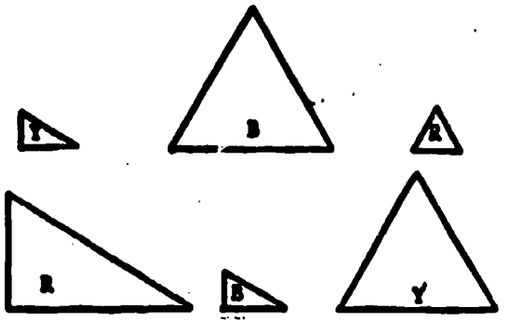
   a. No, some of them are not equilateral triangles.

   b. Yes, all of them are equilateral triangles.

   c. No, none of them are equilateral triangles.

   d. I don't know.

Stop



8. Are all of the small figures above equilateral triangles?

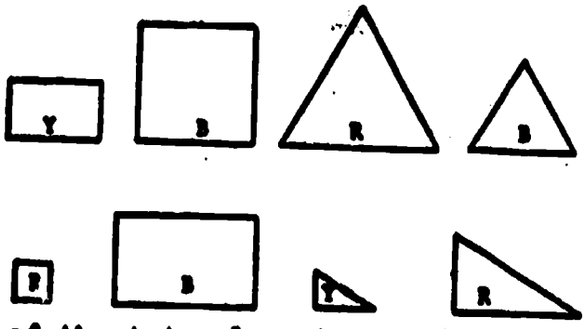
   a. No, some of them are not equilateral triangles.

   b. Yes, all of them are equilateral triangles.

   c. No, none of them are equilateral triangles.

   d. I don't know.

Stop



9. Are all of the triangles above polygons?

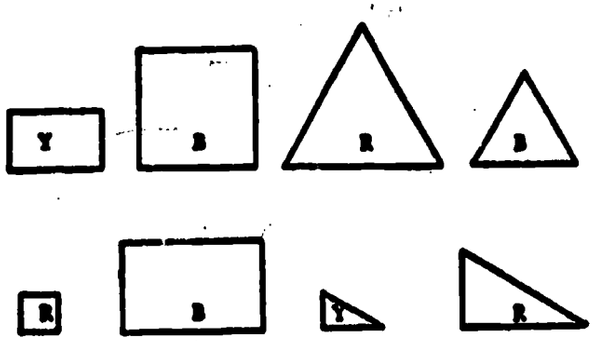
   a. No, none of them are polygons.

   b. Yes, all of them are polygons.

   c. No, only some of them are polygons.

   d. I don't know.

Stop



10. Are all of the polygons above triangles?

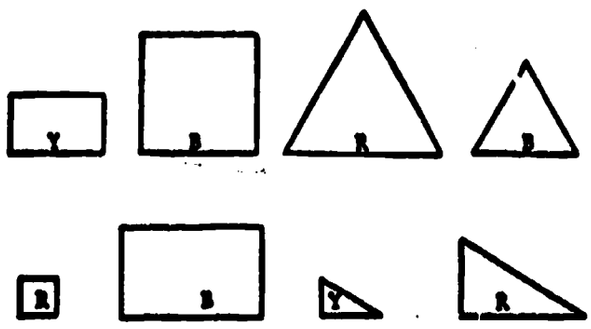
a. No, some of them are not triangles.

b. Yes, all of them are triangles.

c. No, none of them are triangles.

d. I don't know.

Stop



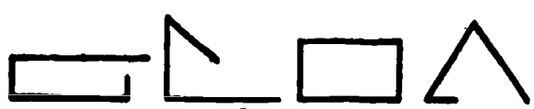
11. If you took all of the triangles and the rectangles above and put them in a group there would be _____ there were polygons.

a. fewer of them than
b. more of them than
c. the same amount of them as
d. I don't know

Stop

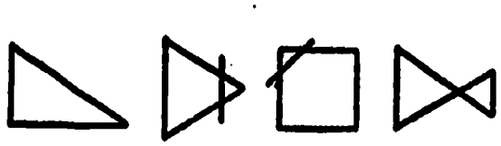
DISCRIMINATING ATTRIBUTES

12.a Below are four drawings. Put an X on the one that is different from the other three.



Stop

12.b Below are four drawings. Put an X on the one that is different from the other three.



Stop

12.c Below are four drawings. Put an X on the one that is different from the other three.

Stop

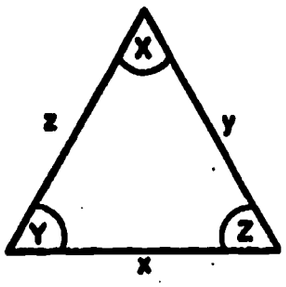
Name_____

Concept Development IC

Klausmeier, H. J., Ingison, L. J., Sipple, T. S., Katzenmeyer, C. G.

Stop

PROBLEM SOLVING



Angles X, Y, and Z have exactly the same number of degrees. Suppose that side y is 2 inches long. How long is side x?

a. 1 inch

b. 2 inches

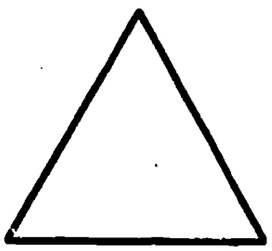
c. 3 inches

d. It is impossible to tell without measuring.

e. I don't know.

Stop

2



Suppose that one side of this equilateral triangle is 2 inches long. The perimeter of the triangle would be_____.

a. 12 inches

b. 6 inches

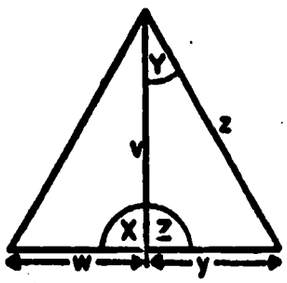
c. 3 inches

d. It is impossible to tell without measuring.

e. I don't know.

Stop

3A



Line v bisects the upper angle of this equilateral triangle. Suppose that side z is 2 inches long. How many degrees are in angle Y?

a. 30°

b. 60°

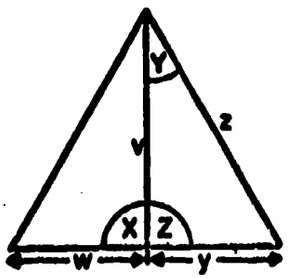
c. 90°

d. It is impossible to tell without measuring.

e. I don't know.

Stop

3B



Line v bisects the upper angle of this equilateral triangle. Suppose that side z is 2 inches long. Line w would then be:

a. 1 inch

b. 3 inches

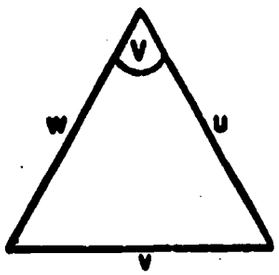
c. 3 inches

d. It is impossible to tell without measuring.

e. I don't know.

Stop

4



Sides u, v and w are of equal length. How many degrees are in angle V?

a. 60°

b. 90°

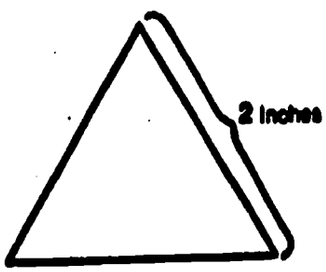
c. 120°

d. It is impossible to tell without measuring.

e. I don't know.

Stop

5



One side of this equilateral triangle is 2 inches long. Suppose that there was a second triangle that was similar to this one. How long would one side of the similar triangle be?

a. 1 inch

b. 2 inches

c. 3 inches

d. It is impossible to tell without measuring.

e. I don't know.

Stop

Name_____

Concept Development ID

Klausmeier, H. J., Ingiśon, L. J., Sipple, T. S., Katzenmeyer, C. G.

Stop

VOCABULARY

1

Suppose that sides x and y are each 3 inches long. Choose the one answer which best describes how side x is like side y. Side x and side y _____.

a. are of even length.

b. are of equal length.

c. coincide in length.

d. I don't know.

Stop

2

Group 1

Group 2

Which one name best fits all of the drawings in Group 1 but does not fit all of the drawings in Group 2?

a. squares

b. trapezoids

c. triangles

d. rectangles

e. I don't know.

Stop

3

What is the one word that best indicates what the arrow is pointing at?

a. angle

b. line

c. side

d. base

e. I don't know.

Stop

4

Group 1

Group 2

Which one name best fits all of the drawings in Group 1 but does not fit all of the drawings in Group 2?

a. symmetrical figures

b. closed figures

c. regular figures

d. I don't know.

Stop

5

What is the one word that best indicates what each arrow is pointing to?

a. angle

b. vertex

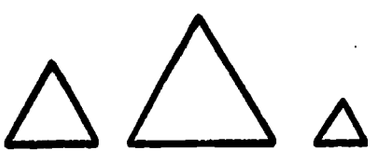
c. side

d. straight edge

e. I don't know.

Stop

6



Group 1

Group 2

Which one name best fits all of the drawings in Group 1 but does not fit all of the drawings in Group 2?

a. scalene triangles

b. right triangles

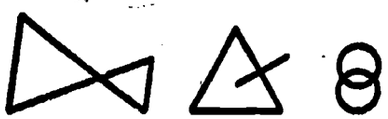
c. obtuse triangles

d. equilateral triangles

e. I don't know.

Stop

Group 1



Group 2

Which one name best fits all of the drawings in Group 1 but does not fit all of the drawings in Group 2?

a. symmetrical figures

b. simple figures

c. regular figures

d. I don't know.

Stop

Appendix F

Measure of Subjects' Attention

Measure of Subject's Attentiveness

Instructions to Observer:

At two minute intervals, observer will note the degree of each S's attending to the on going task. Possible activities for Ss to be engaged in are:

A. listening to E's instructions and observing E
B. responding to E's instructions
C. manipulating stimulus materials

After each two minute interval, observer should note the activity and each S's attentiveness.

		Not Attending 0%	Attending A Small Amount Of The Time 25%	Attending Half Of The Time 50%	Attending A Large Amount Of The Time 75%	Attending All Of The Time 100%
Time-2:00						
	S_1					
	S_2					
Activity___	S_3					
	S_4					
	S_5					
Time-4:00						
	S_1					
	S_2					
Activity___	S_3					
	S_4					
	S_5					
Time-6:00						
	S_1					
	S_2					
Activity___	S_3					
	S_4					
	S_5					

		Not Attending	Attending A Small Amount Of The Time	Attending Half Of The Time	Attending A Large Amount Of The Time	Attending All Of The Time
		0%	25%	50%	75%	100%
Time-8:00						
	S_1					
	S_2					
Activity___	S_3					
	S_4					
	S_5					
Time-10:00						
	S_1					
	S_2					
Activity___	S_3					
	S_4					
	S_5					
Time-12:00						
	S_1					
	S_2					
Activity___	S_3					
	S_4					
	S_5					
Time-14:00						
	S_1					
	S_2					
Activity___	S_3					
	S_4					
	S_5					

Appendix G

Teacher Evaluation Form

Evaluation of Classroom Instruction on a Select Number of Words

Please indicate which of the following words your class has studied since the beginning of the current school year. Also, please indicate to the best of your knowledge whether or not your class has received instruction in prior school years on the words listed below.

	Yes	No	If Yes, Please Give Approximate Date
polygon			
pentagon			
regular pentagon			
triangle			
equilateral triangle			
perimeter			
open figure			
closed figure			
simple figures			
angle			
shape			
sides			
equal			
three			
five			

Signature_____

Date_____

Appendix H

Raw Data for Levels Subtests

CONCEPT ATTAINMENT SCORES

Subject	Concrete	Identity	Classificatory	Formal	
				Discrim.	Attributes	Vocab.
Low MA Normal - Treatment III						
1	8	8	2	1	1
2	8	7	1	1	1
3	8	8	1	2	1
4	5	4	1	2	1
5	7	8	2	1	0
6	8	8	0	2	1
7	8	7	3	1	2
8	8	8	2	0	2
9	8	8	1	2	0
10	8	8	5	2	2
High MA Normal - Treatment II					
11	8	8	2	3	4
12	8	8	3	3	4
13	8	8	3	1	3
14	8	8	3	2	4
15	8	8	3	1	4
16	8	8	1	0	4
17	8	8	3	2	2
18	8	8	3	1	5
19	8	8	3	3	3
20	8	7	3	3	3

CONCEPT ATTAINMENT SCORES

Subject	Concrete	Identity	Classificatory	Formal	
				Discrim. Attributes	Vocab.
High MA Normal - Treatment IV					
21	8	8	3	1	2
22	8	8	2	2	1
23	8	7	3	3	2
24	8	8	3	1	0
25	8	8	2	0	4
26	8	8	3	2	2
27	8	8	1	2	3
28	8	8	3	3	3
29	8	8	3	1	3
30	8	8	3	3	3
Low MA EMR - Treatment IV					
31	8	8	3	1	1
32	8	8	2	3	1
33	8	8	3	0	3
34	7	8	0	1	1
35	5	7	3	2	2
36	4	6	3	1	1
37	6	6	1	3	1
38	8	8	2	3	1
39	8	8	3	3	1
40	8	8	3	0	0

CONCEPT ATTAINMENT SCORES

Subject	Concrete	Identity	Classificatory	Formal	
				Discrim. Attributes	Vocab.
Low MA EMR - Treatment III					
41	5	4	3	1	3
42	8	8	3	2	1
43	8	7	2	0	3
44	8	7	2	0	4
45	8	8	3	0	3
46	8	8	3	0	0
47	8	7	2	2	5
48	7	7	3	0	0
49	6	5	3	2	0
50	8	8	1	1	2
Low MA EMR - Treatment II					
51	8	8	3	2	4
52	6	7	1	1	5
53	8	8	3	2	5
54	8	8	2	1	5
55	8	8	1	0	5
56	8	8	2	0	5
57	8	7	0	2	2
58	3	5	0	1	0
59	8	8	3	0	2
60	8	8	3	2	4

CONCEPT ATTAINMENT SCORES

Subject	Concrete	Identity	Classificatory	Formal	
				Discrim. Attributes	Vocab.
High MA Normal - Treatment III					
61	8	8	3	1	3
62	8	8	3	0	3
63	8	8	2	3	2
64	8	8	2	2	3
65	8	8	3	3	2
66	8	8	3	2	3
67	8	8	3	2	1
68	8	8	3	2	3
69	8	8	3	0	2
70	1	1	1	0	5
High MA EMR - Treatment IV					
71	7	8	2	2	3
72	8	8	3	3	1
73	7	8	2	3	2
74	8	8	3	0	1
75	8	8	2	1	2
76	8	8	3	3	3
77	8	8	3	1	3
78	8	8	2	2	1
79	8	8	3	3	3
80	8	8	3	2	2

CONCEPT ATTAINMENT SCORES

Subject	Concrete	Identity	Classificatory	Formal	
				Discrim. Attributes	Vocab.
High MA EMR - Treatment II					
81	8	8	3	2	6
82	8	7	3	3	3
83	8	8	3	0	5
84	8	8	2	0	4
85	8	8	3	2	4
86	8	8	0	1	3
87	7	7	3	1	4
88	8	8	3	2	5
89	8	8	3	3	3
90	8	8	3	1	4
High MA Normal - Treatment I					
91	8	8	3	0	3
92	8	8	3	3	3
93	8	8	3	2	4
94	7	7	3	0	3
95	8	8	1	2	3
96	8	8	2	2	3
97	8	8	3	1	3
98	8	8	3	1	3
99	8	7	2	3	4
100	8	8	3	3	3

CONCEPT ATTAINMENT SCORES

Subject	Concrete	Identity	Classificatory	Formal	
				Discrim. Attributes	Vocab.
Low MA ESR - Treatment I					
101	8	8	2	1	4
102	7	8	1	2	3
103	8	7	3	1	3
104	8	8	3	0	2
105	8	8	3	1	2
106	8	7	3	2	3
107	0	2	2	1	3
108	8	7	3	1	3
109	8	8	3	1	4
110	8	5	3	1	4
Low MA Normal - Treatment IV					
111	8	8	1	0	1
112	7	8	1	3	0
113	8	8	1	0	0
114	7	7	1	1	1
115	8	7	3	1	1
116	8	8	2	1	1
117	8	8	3	0	1
118	8	8	1	0	0
119	8	8	2	0	2
120	8	8	2	2	0

CONCEPT ATTAINMENT SCORES

Subject	Concrete	Identity	Classificatory	Formal Discrim.	Formal Attributes	Vocab.
High MA EMR - Treatment I						
121	7	8	3		3	4
122	8	8	3		0	4
123	8	8	3		3	3
124	8	8	1		2	2
125	8	8	3		0	3
126	8	8	3		0	3
127	8	8	3		3	2
128	8	7	3		0	4
129	8	8	3		3	4
130	8	8	2		1	4
Low MA Normal - Treatment I						
131	8	8	2		1	3
132	7	8	3		0	2
133	8	8	3		3	4
134	7	8	2		2	3
135	8	8	1		3	2
136	8	8	3		2	2
137	8	8	3		0	3
138	8	8	3		1	4
139	7	7	3		2	3
140	7	7	3		3	2

CONCEPT ATTAINMENT SCORES

Subject	Concrete	Identity	Classificatory	Formal	
				Discrim. Attributes	Vocab.
Low MA Normal - Treatment II					
141	8	8	2	0	6
142	7	7	3	0	4
143	8	8	2	3	4
144	8	8	3	1	4
145	8	8	1	0	4
146	8	8	2	1	5
147	8	8	2	0	5
148	8	7	2	3	4
149	7	8	3	2	3
150	8	8	2	3	3
High MA EMR - Treatment III					
151	8	8	3	1	2
152	8	8	2	1	3
153	8	8	3	0	4
154	8	7	3	3	3
155	8	8	3	3	2
156	8	6	3	0	1
157	8	8	3	3	3
158	5	8	3	3	3
159	8	6	3	2	2
160	8	8	3	2	3

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