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DEVELOPMENTAL IMPLICATIONS IN THE SOCIAL LEARNING OF CONCEPT ATTAINMENT

by

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ABSTRACT

The ability of E.C.S. and Grade 1 children to induce a two dimensional concept through silent modeling, rule repetition or a combination of modeling plus rule repetition, was examined. It was hypothesized in accordance with Bruner's (1964; 1966a; 1966b) theory, that there would be no significant difference in performance between E.C.S. and Grade 1 children, and that children of this age would not be able to induce the conceptual rule unless they were given the necessary verbal mediators which were supplied to them in the rule repetition or the modeling plus rule repetition conditions.

An analysis of variance with repeated measures from baseline to concept acquisition to concept generalization was carried out. The major hypotheses were supported, in that there were no significant differences found in the ability of the E.C.S. and Grade 1 children to attain the concept. Further, the results showed that the provision of the rule was critical for teaching children of this age a two dimensional concept, and that they had difficulty inducing the concept under the silent modeling condition. The results were taken as support for Bruner's developmental theory of concept attainment.

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TABLE OF CONTENTS

CHAPTER Page

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

GENERAL INTRODUCTION

The major focus of the present investigation was to examine the developmental implications of teaching a concept attainment task using a social learning paradigm.

Social learning theory (Bandura, 1977) is based on the premise that people learn behavior through the observation of models. The observer is expected to extract the important features from the modeled behavior and reproduce or imitate them. In order for observational learning to occur, there must be attention to the modeled behavior, the cognitive and physical ability to perform the behavior, sufficient incentive to warrant performance and adequate representational processes to retain it.

Bandura (1977) proposes that observational learning relies on two representational processes, either imaginal or verbal in nature. Imaginal representation is required for simple modeled behavior, while more complex, abstract behavior is dependent upon verbal representation. Although he indicates a progression from imaginal to verbal representation as a person matures, there is no specific information available to indicate when these systems come into play and how they interact in adulthood.

Bruner (1964; 1966a; 1966b), on the other hand, proposes a developmental theory which, although similar in a number of ways to that of Bandura, clearly indicates how age and development relate to representational processes. Specific age ranges for each level of representation are laid out, as well as how they interact with one another. Of particular relevance to this study is Bruner's hypothesis that children between the ages of 5 and 7 are in a transitional stage between ikonic and symbolic representation. Although these children are hypothesized to have the ability to use symbolic representation, they are unable to spontaneously provide the verbal mediators to access it. Further, since according to Bruner, concept attainment requires symbolic representation, it is hypothesized that these children could learn more complex concepts by providing them with the necessary verbal mediators rather than relying strictly on a modeling paradigm, where they would have to supply their own.

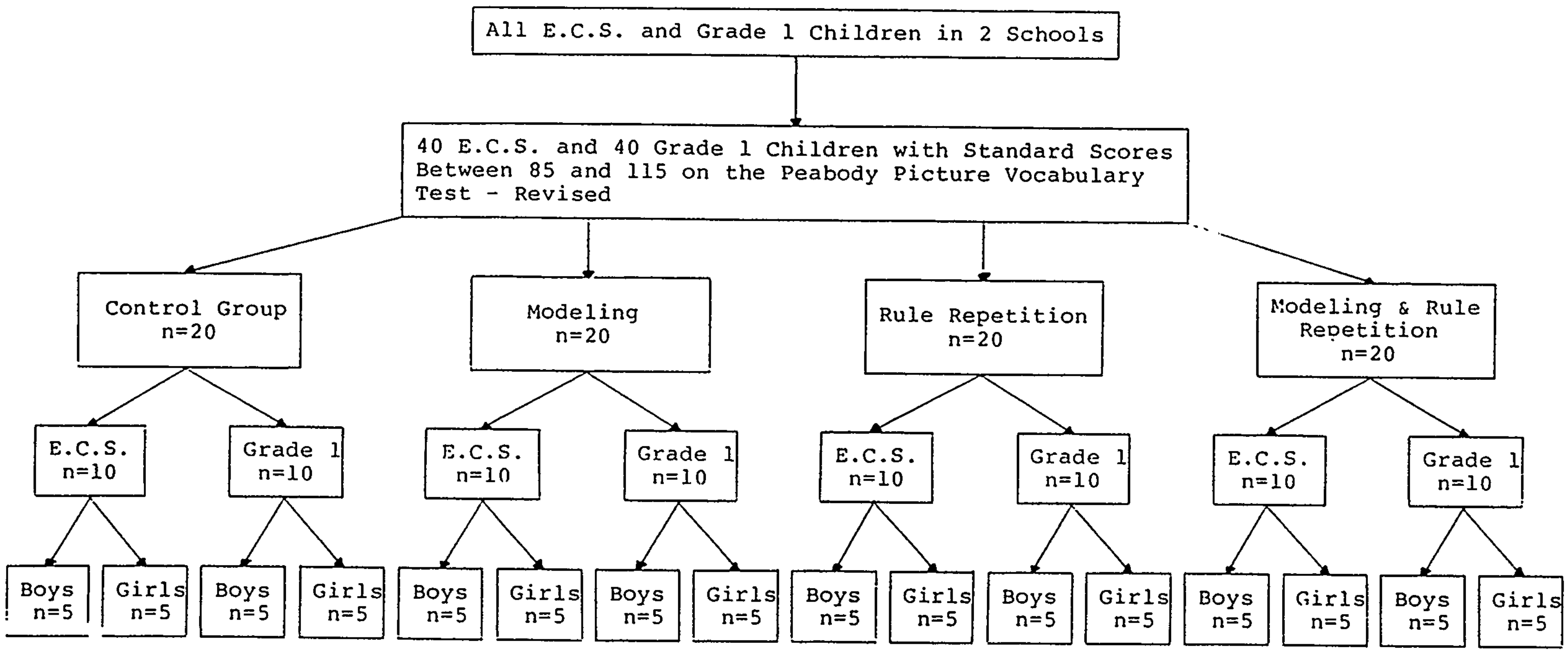
MacFadyen (1985) investigated the hypothesis that performance on a concept attainment task would be facilitated by the presentation of a verbal rule for younger children who hypothetically had less well developed verbal skills. When comparing the performance of Grade 1 and Grade 4 students using silent modeling and rule repetition conditions on a two dimensional concept attainment task, it was found that the younger children were at a distinct disadvantage when no verbal mediation was provided.

The purpose of the present study was to extend MacFadyen's research to examine concept attainment in a similar way, with even younger subjects. This study was carried out using a group of E.C.S. and Grade 1 children. The ability to learn a two dimensional concept attainment task and the combinatory rule was compared using modeling, rule repetition and modeling plus rule repetition conditions. It was hypothesized that both groups of children would require the rule to be stated as a part of the instructional condition in order for them to generalize and be able to induce the rule. It was also of interest to determine whether the combination of visual and verbal presentation would make the information more accessible to the transitional child, or whether the provision of the rule alone would be the critical factor. A flow chart of the experimental design is presented in Figure 1.

The following two chapters will review the literature as it relates to both developmental and social learning schools of thought, as well as the experimental support.

FIGURE 1

Flow Chart of Experimental Design



CHAPTER II

DEVELOPMENTAL THEORIES OF CONCEPT REPRESENTATION AND ATTAINMENT

Theorists such as Bruner, Flavell, Piaget, Ausubel and Vygotsky have all contributed greatly to our understanding of conceptual development. While the theory of Bruner is the primary focus in the present study, it is important to examine the others briefly as well. Maccoby (1980) sees four main themes that bind these theories together:

> 1. As children mature, their conceptual abilities develop in certain fairly predictable sequences. At any given time an individual child may make use of several levels of thought and may not make use of the highest level of which he or she is capable. Nevertheless, within this variability is a consistent thread of forward movement.
> 2. Most children go through sequences without skipping steps and without going backward. That is, progress is relatively irreversible.
> 3. The developmental changes in thinking are structural changes. That is, they represent changes in the way information is organized and in the mental activities, or operations, that the child performs with the information at hand. Structural change is not just a matter of accumulating more and more items of information.
> 4. The impact of any environmental event on a child will depend on what the child takes from that event -- how the child interprets what has happened and how the new information is integrated with what the child already knows. Children are active participants in their own learning. Indeed, they set the pace.
>
> (Maccoby, 1980, p. 20-21)

The ideas of developmental sequences and structural changes are fairly specific to developmental theorists and are not consistent with those held by learning theorists such as Bandura. These differences will be further examined in Chapter III.

The following section will review the various developmental theories with respect to representation and mediation as they relate to conceptual development, in order that predictions can be made in relation to the present study.

The Theory of J.S. Bruner

Bruner (1966a) outlines three basic themes that are essential to his conception of cognitive growth, and the conditions that shape it; namely, representational processes, culturally transmitted implementation systems, and man's capacity to adapt to his environment using social and technological means. The first theme is the one of primary interest in terms of this research. It involves the way people represent their experience of the world and how they organize what they have encountered for future use. Bruner (1964; 1966a; 1971) proposes that there are three modes of representation, or ways of processing information: a) through action (enactive representation); b) through imagery (ikonic representation); and c) through symbols (symbolic representation). Each of these systems plays a specific role in a child's development at different ages, although there is still considerable interaction between them in adulthood.

Representation

In order that we benefit from our environment, it is necessary that we represent it in some way. Representation ". . . can be effected in the media of symbols, images and actions and that each form of representation can be specialized to aid symbolic manipulation, image organization, or the execution of motor acts" (Bruner, 1966a, p. 11). It should be kept in mind that although each of the systems are parallel and unique, they are all capable of interacting with one another.

The first mode of representation that Bruner (1964; 1966a) outlines is enactive representation. This process involves representing past events through motor responses and lasts from birth to approximately one year. The innate action of looking is the initial form of action used by the infant, followed by mouthing and grasping. These actions act as a link between the child and his environment, and are carried out without either imagining or verbally labeling them.

Ikonic representation, which usually occurs by the end of the child's first year, Bruner (1964) defines as the summary ". . . of events by the selective organization of percepts and of images, by the spatial, temporal and qualitative structures of the perceptual field and their transformed images" (p. 3). Here the child is able to represent the world to himself relatively independently of action, although his image of the world tends to be inflexible, dependent on small details, self-centered and susceptible to distortion

(Bruner, 1966a).

The transition between ikonic and symbolic representation generally occurs between the ages of five and seven years (Bruner & Kenney, 1966). This is of particular interest here since all of the subjects in this study fall somewhere in the transition phase. Although children of this age have acquired language, its development does not necessarily signify that the child has lost his dependence on perceptual attributes. Instead it merely provides the necessary conditions for symbolic representation to occur (Bruner, 1966b). During this time, the child must learn to overcome his dependence on perceptual stimuli in order for conceptual learning to take place (Oliver & Hornsby, 1966).

Symbolic representation ". . . stems from a form of primitive and innate symbolic activity that, through acculturation, gradually became specialized into different systems" (Bruner, 1966b, p. 30). The most common of these systems is language. The symbolic process represents things by design features that are not compatible with enactive or ikonic forms of representation. These features include remoteness (i.e. symbols can be temporally distant), arbitrariness (i.e. symbols do not resemble what they stand for), and their ability to be used in productive combinations (Bruner, 1964). In order to develop symbolic representation, the child must learn to bring his thinking and experience under the control of what he has learned linguistically (Bruner, 1966b).

Experimental Support

Ample evidence exists which supports the idea of a developmental shift in representation processes with respect to both concept acquisition and conservation learning.

Worthington, Typpo and Worthington (1980) studied the effectiveness of teaching preschoolers, aged 34 to 59 months, a spatial concept task using instructions, verbal repetition, fine motor and gross motor treatments. They found no significant differences between the two verbal groups, and that both motoric groups did significantly better than those using verbal treatments. These authors concluded that motor involvement in the learning of spatial concepts is an effective instructional technique for use with preschoolers. The results from this study would be expected according to Bruner's theory because these children would have not yet reached the transitional stage between ikonic and verbal representation and thus would not have been able to use the supplied verbal mediators to enhance performance.

Blank (1974) proposed that in the absence of visual spatial information, children would use their verbal systems more effectively. A study was done to test this hypothesis (Blank, 1975), with children aged 3-5 to 4-6 years. Using reinforcement, children were taught a two choice discrimination task, where they were required to choose between a red circle and another object, with the red circle being the correct choice. After making their choice, they were required to verbalize it, by answering two types of questions (e.g., "Which one did you choose?", and "How did you choose that one?"). Half of the children were required to answer the question with the object in view and the other half with it hidden. Results showed that the "which" question was significantly superior in eliciting verbalizations than the "how" question. Further, 13 of the 16 children were able to answer the "which " question when the object was out of sight, whereas only 1 out of 16 was able to answer when it was present. Although in her discussion, Blank concedes that this study does have implications in the area of verbal mediation, she does not address these issues. She merely concludes that in order to elicit verbalization most effectively with children of this age, a "which" type of question is superior to a "how" type of question. That the children were able to answer more "which" than "how" questions, appears predictable since the "which" question merely asks for a verbalization of the choice, whereas the "how" question requests the rule accompanying the choice. Children of this age would not be expected to be able to induce the rule, particularly through a reinforcement paradigm. Further, the fact that the children had difficulty answering the questions with the object in view, would provide support for Bruner's hypothesis that the predominant perceptual cues would confound verbalization for children still using ikonic representation.

The developmental shift in representation from ikonic to the transition between ikonic and symbolic representation is demonstrated in the following study. Majeres and Fox (1984) looked at how children aged 3 to 7 years were able to learn that the relevant concept was always the larger of the two real-world objects. In the first of two experiments, pictures from the Peabody Picture Vocabulary Test were chosen to represent pairs of different objects of different sizes (e.g., cow-pencil, wagon-banana, clown-scissors, etc.). In addition, the pictures were enlarged to 1 1/3 times the original and reduced to 2/3 the size of the original. Each picture pair included one enlarged and one reduced picture, with all pictures equally represented in each form. S's were required to "point to the big one", with corrective feedback and reinforcement given for the correct choice of the largest real-world object. They found that the 5 1/2 to 7 year olds were able to learn the concept in approximately 3 trials, whereas the younger children never did. The authors concluded that a marked improvement in the ability to go beyond immediate perception to solve problems occurred between 5 and 6 years of age.

Because the authors felt that theconcept may have been too difficult for the younger S's, they conducted a second experiment. Children from 4 to 6 years old were given a similar task where the correct choice was either green or red, and all of the pictures were the same size. For half of the children, red was the correct colour and for the rest, the correct colour was green. Instead of being asked to pick the "big one", S's were asked to pick the "right colour". Corrective feedback and reinforcement were given as before. Results showed that in this situation, the performance of 5 year olds equalled that of 6 year olds, and exceeded that of the 4 year olds. The authors suggest that when the relevant concept is perceptually available, children as young as 5 are able to attain the concept. They conclude that in accordance with Bruner's theory, the 3 and 4 year olds must be dependent upon ikonic representation where they are rigid and unable to go beyond the immediate perception, whereas the older children have a more adaptive representational system which allows them more freedom from perceptually given information.

Cramer (1976) did a study using a word association task with Grade 1 and 4 children, where 15 stimulus words were paired with their primary associative responses (e.g. knife-fork). There was also a set of 15 control items which had no associative connections with the other two lists. All items were drawn up so that they could be depicted either verbally or visually. The children were assigned to one of three conditions; verbal (word condition), visual (picture condition) or visual-verbal (picture-word condition). After the training session, the children were presented with both the word association items plus the control list in the same mode as before and asked which were old items and which were new items. Results showed that Grade 4 S's made significantly more correct identifications than did the Grade 1 S's and that the picture and picture-word conditions were significantly more effective than the word condition. An analysis of errors showed that Grade 1 S's made significantly more errors with the visual presentation than they did with the other forms of presentation. The authors suggest that Grade 1 children still have strong visual associations and therefore, a visual presentation is likely to be stored visually in memory. In order for them to reduce errors, verbal mediators are required so that they are more able to organize the material in an adequate fashion. This is consistent with Bruner's view, that children in transition do not spontaneously abstract verbal concepts, and that only through verbal presentation are they able to overcome predominant perceptual attributes.

In a study by Kossan (1981), the concept acquisition strategies of second and fifth graders were found to differ significantly. Two experiments were carried out using a 2 (grade) x 2 (concept types) x 2 (conditions) design. Only the concept types were changed between the two experiments. The first looked at concepts defined by a two feature rule (e.g. All animals with a long neck and a straight tail), and those with sufficient but not defining features (e.g. Animals with 3 or 4 characteristics out of 5 necessary for classification). Half of the children at each grade were assigned to either the concept reception condition or the paired associate condition. S's in the concept reception condition were told to label the animals as one of two types, either "zonks" or "nonzonks" (i.e. an abstraction strategy). In the paired associate condition, S's were required to learn the animals by an assigned name such as "Tom" (i.e. an exemplar strategy). Within these groups, half of the children learned the rule defined concept and half the sufficient features concept. Results showed a main effect for grade, where S's in Grade 5 correctly classified more animals than did S's in Grade 2. A main effect was also found for condition, where S's in the concept reception condition, using the abstraction strategy were more successful than those in the paired associate condition who used an exemplar strategy. A significant interaction effect was found between grade, condition and concept type, where second graders were able to categorize the rule defined concept only in the concept reception (i.e. abstraction) condition. Second graders in the paired associate (i.e. exemplar) condition were most successful with the sufficient features concept. Fifth graders found the abstraction strategy in the concept reception condition most helpful for learning both concept types. Kossan suggests that for the Grade 2 S's, the concept reception condition applies best to concepts where distinct common features can be abstracted, whereas paired associate or exemplar learning works most effectively with unique relatively undefined characteristics. That is, the Grade 2 S's were not yet able to use abstraction with the sufficient features concept. This could be hypothesized from Bruner's formulation, where children in the transition phase would not use verbal processes such as abstraction spontaneously.

In an effort to support Kossan's hypothesis that S's in the concept reception condition used abstraction, while those in the paired associate condition used an exemplar strategy to learn the concept, a second experiment was done. This experiment was conducted using the same S's and conditions as outlined previously. The concept types were changed to those with common defining features (e.g. Animals with wings and feathers; namely, birds) and those with unique distinctive features (e.g. Birds with red breasts; namely, robins). Results showed that significantly more S's from both age groups in the paired associate (i.e. exemplar) condition correctly classified both types of concepts, than they did in the concept reception (i.e. abstraction) condition. The Grade 2 S's, however tended to use the exemplar strategy more often, regardless of the training procedure. Kossan feels this study supports the hypothesis that the exemplar strategy allows for the child to learn concepts defined by both common and distinctive features. She further points out that while common feature abstraction is an effective strategy for simple concepts (e.g. concepts defined by a two feature rule), more complex concepts (e.g. concepts defined by sufficient or distinctive features), particularly with younger S's, require another strategy. Kossan concludes that the exemplar strategy provides the younger child with a concept acquisition strategy, he is developmentally ready for.

Olver and Hornsby (1966) did a series of experiments to see if children who used different modes of representation, emphasized differing bases for establishing equivalence. The first study used S's aged 6 to 19 years to examine how they grouped words such as banana, peach, potato and meat as being alike. Results suggested that the 6 year olds were relying primarily on ikonic representation, as they based their decisions most often on perceptual attributes such as colour and shape, while those over 11 years of age relied more on symbolic processes. In other words, they tended to induce a general rule for a particular classification (e.g. "They are all food").

The second study used pictorial stimuli rather than words to determine whether the overt presentation of perceptual attributes would alter the modes of representation used. They found that although older S's still made significantly more symbolic classifications than the 6 year olds, the frequency of using perceptual attributes increased overall with the pictorial as opposed to the verbal presentation of stimuli. These results stress the importance of the mode of presentation in terms of a S's ability to use ikonic versus symbolic representation, particularly for young children in transition. The authors also suggest that for the younger child, equivalence is based primarily on ikonic representation, and as the child matures, linguistic structures play a more significant role in how and why things are judged alike.

Sonstroem (1966) conducted an experiment to test whether verbal labeling, and/or direct manipulation of materials aided in learning the conservation of solids. All children were pre-tested so that only nonconservers participated in the study. The basic procedure consisted of changing the shape of a ball of clay through eight combinations of direct manipulations, screening and verbal labeling. At post-test, the percentage of children showing conservation from the screening condition, was not significantly higher than that of the children in the no training group. Manipulation training showed significant gains but only in combination with verbal labeling. Sonstroem concluded that by providing the child with both enactive and symbolic modes of representation as an alternative for overcoming the predominant perceptual cues, new learning could be induced for the children in transition.

Bruner's theory would suggest that the imposed conceptual ordering of attributes by providing a verbal label or rule will enhance generalization and thus make symbolic representation more readily available to the child in transition. Melkman, Tversky and Baratz (1981) did a study using a conceptual grouping task with 4, 5 and 9 year old children. The children were required to group pictures on the basis of either colour, form or taxonomy. Initially, a recall procedure was used where the children were presented with pictures from each group and then asked to remember specific pictures belonging to each respective group. Following this, the children were administered a grouping task, where they first had to label all of the pictures and then were shown one picture separate from the others and asked to point to the picture which belonged to the same group. These researchers found a significant effect for age, where 4 year olds relied primarily on colour and form, 5 year olds on form alone, and 9 year olds on taxonomic categories (e.g. musical instruments). Younger children tended to use cues most easily available to perception for spontaneous groupings, but were at a distinct disadvantage when retrieving the information from memory. Even the youngest children however, were able to retrieve the information if they were given the appropriate abstract category. The authors feel that this study supports a chronological progression in terms of the attributes used for grouping objects from colour to form to concept. Further, they take the study as evidence for a shift in the organization of stimuli in memory from reliance upon perceptual to conceptual features, as the child matures. These results support Bruner's position that when transitional children are supplied with a verbal label, they are able to use it, even though they would not be able to supply it themselves and use it spontaneously as older children would.

Denney and Moulton (1976) found a similar shift in conceptual preferences by young children aged 3, 4, 5 and 9 years. S's were shown an array of 42 coloured pictures of common objects and were asked to "point to two pictures that are alike or go together in some way." They were then asked to explain their judgments, and their explanations were scored in terms of one of the following eight concept types: a) perceptible concepts (those with common elements, colours, numbers or contexts); b) functional concepts (those possessing the same intrinsic or extrinsic functions); c) nominal concepts (those possessing a common superordinate label); d) similarity concepts (those resulting from the sum of the above concepts); e) complementary concepts (those which are functionally or thematically related); f) affective responses (those based on like or dislike); g) naming responses (those which are simply named but not really clustered); and h) nonclassifiable responses. The results showed a distinct developmental trend from complementary to perceptible to functional to nominal concepts. Specifically, they found complementary concepts to increase between the ages of 3 and 4, but remain stable after that point. Between 4 and 5 years of age, perceptible concepts increased but then showed a decline between the ages of 5 and 9. Functional concepts increased from 4 to 5 and then showed a more evident increase between the ages of 5 and 9. Nominal concepts were found only with the 5 and 9 year olds and showed a steady increase between the two groups. The authors concluded that there is a concrete-abstract shift in conceptual preferences as children get older. This study can be seen as supporting the move from dependence upon perceptual attributes while in the ikonic or transitional stages to those which are more abstract and require symbolic representation.

That labeling assists children in the transitional stage is evidenced in a study by Yussen and Sanstrode (1974) using a picture naming task with 5 and 8 year olds. There were three conditions; no verbalization, observer verbalization and performer verbalization. They found that providing the children with verbal labels in a picture naming task, significantly enhanced recall for the 5 year olds, particularly when they were able to verbalize the label themselves. The label in effect, provides the children with a verbal mediator which allows them to store the information more efficiently.

In summary, there is experimental evidence which suggests a developmental shift in representation processes, and that children between the ages of 5 and 7 are in a transitional phase between ikonic and symbolic representation.

The research presented here supports the view that children in transition are generally not able to verbally induce abstract concepts spontaneously. It is proposed that in order for a transitional child to benefit from an instructional paradigm, verbal representation in the form of labels, instructions or rules must be provided.

Related Theoretical Approaches

John Flavell

An intermediate position to that of Piaget's and Bruner's is held by Flavell (1970). Flavell and his associates have studied the developmental aspects of mediated memory quite extensively and have concluded that " . . . even immature human S's may variously engage in spontaneous verbal, ikonic or enactive forms of representational activity in their efforts to retain information" (Flavell, 1970, p. 194). This conclusion, while supporting Bruner's view of modes of representation, suggests that there are no clear age distinctions between them. Flavell instead focuses primarily on mediation or production deficiencies. A mediation deficiency is said to exist when the child has the ability to produce the necessary mediator, but is unable to use it in an adaptive way. A production deficiency, on the other hand, exists when the child is unable to generate the mediator spontaneously, but may be able to use it effectively if it is supplied to him.

While the mediation deficiency hypothesis is difficult to support experimentally due to the interference of extraneous variables, such as lack of comprehension with respect to the task or the use of inappropriate mediators, there does appear to be support for the idea of a production deficiency (e.g., Flavell, Beach and Chinsky, 1966; Corsini, Pick and Flavell, 1968).

There is a marked similarity between Flavell's production deficiency hypothesis and Bruner's view of children in transition between ikonic and symbolic representation. Bruner would suggest that although transitional children are unable to spontaneously verbally mediate, if the necessary mediator was provided to the child, he would be able to use it. The inherent difference between the two positions is that Flavell has not articulated at what age induced mediation would be successful, and under which conditions. Bruner, on the other hand, is quite clear as to the fact that the child must be in the transitional stage, between 5 and 7 years of age, to benefit from instruction which supplies the verbal mediators that ordinarily only a child in the symbolic stage would be able to use spontaneously.

<u>Jean Piaget</u>

In contrast to Bruner, who focuses on the interactions of the representational processes, Piaget emphasizes the role of operations in the representation of the world (Peill, 1975). While the process of thinking can be represented by images, or symbols, it is only known through operations. Piaget and Inhelder (1976) outline the four main operational stages, namely; the sensorimotor stage, which usually occurs from birth to 2 years; the preoperational stage, from 2 to 7 years; the concrete operational stage, from 7 to 12 years; and the formal operational stage, from 12 years to adult.

According to Piaget, action is central to the acquisition of operations which are necessary in order for the child to cope with his environment. Verbal representation is not seen to be a necessary condition for intellectual development to occur. All experiences of the child are represented by schema which are either assimilated or modified with every related experience the child has. In this way, the child experiences and reacts to the environment in terms of an already existing organizational structure.

The process of assimilation is said to occur when the child takes in information at any level and incorporates it into already existing schemata. At the same time, accommodation occurs, that is, the process by which the schemata are modified to adapt to the perceived reality. However, when an experience cannot be assimilated into an existing schema, disequilibrium occurs, whereby the child must accommodate the experience into a new schema, and in this way, new learning occurs.

New rules and concepts are developed through the recombination of ones that are already in existence. This process depends upon a representational system which codes both actions and situations as well as a process which acts on the representations to produce the new rules and concepts. Therefore, the representation system must be able to accommodate or adapt to new types of input through the recombination of present schemata.

According to Piagetian theory, concept attainment and conservation cannot occur until the child has reached the concrete operational stage of development, where the child's learning strategy changes from being primarily intuitive to very concrete and logical. Concept attainment and conservation cannot be artificially induced before the child reaches this stage at approximately age 6 or 7, and should such learning occur, it would not be expected to generalize.

This is contrary to Bruner's (1964) view, since his theory of cognition depends upon verbal representation for full cognitive development. According to Bruner, verbal mediation can be induced through verbal instruction for the child in transition and thereby provide the necessary prerequisites for concept acquisition and conservation to occur.

David Ausubel

Ausubel, Novak and Hanesian (1978) have a position on the development of concept acquisition which draws significantly from Piagetian theory. A great deal of importance is placed on concept acquisition. Ausubel feels that reality is experienced through a "conceptual filter", and that conceptual development is determined by both the culture in which one lives as well as through the individual's idiosyncratic experiences.

Ausubel and his associates delineate two types of concept acquisition, namely, concept formation and concept assimilation. Concept formation is characteristic of preschool children who are dependent upon concrete - empirical experience. Typically, this requires the identification of the common criterial attributes of a particular class of stimuli, through a process of abstraction, differentiation, and generalization. Concept assimilation, on the other hand, does not necessarily require this process because more complex concepts have often already been culturally determined. Concept assimilation occurs from school age through adulthood, where concepts are no longer discovered inductively through concept formation, but instead are taught through definition. New concepts are learned through the presentation of criterial attributes and are then related to already established relevant ideas in their cognitive structures.

Ausubel's stages of development closely follow those of Piaget, although he places more emphasis on the importance of language and does not believe in the relevance of assigning specific age ranges to the developmental stages. Although he stresses the importance of language, it is not seen to be either necessary or sufficient for concept acquisition to occur.

From the preoperational to the abstract operational stages,

> . . . there are progressive gains in the level of abstraction at which the process of concept acquisition occurs, in the level of abstraction of the concept meanings that emerge from this process, and in the abstractness and complexity of the kinds of concepts that lie within the child's grasp.
> (Ausubel, Novak and Hanesian, 1978)

The preoperational child is limited to "primary concepts", which consist of perceptible objects and events. At the concrete operational stage, the child can deal with "secondary concepts", that is, he is able to form concepts without them being accompanied by concrete-empirical experience. Children at this stage are still restricted and concept meanings remain "semiabstract, sub-verbal" and not too far removed from their personal experience. The highest level of concept acquisition occurs during the abstract logical operational stage, at approximately the beginning of junior high school, where complex concepts can be understood without relying on concrete-empirical "props" and language provides the person with precise, explicit and abstract ideas.

Contrary to Bruner's theory, language remains relatively unimportant until the child reaches the abstract operational stage and complex concepts which require verbalization are not available until that time.

L.S. Vygotsky

Vygotsky (1962-1978) and his associates have done most of their research in the area of language, although much relates directly to cognitive development as a whole. Like the previous theorists, Vygotsky stresses the movement from action to perception to language. Unlike them, he believes in the importance of language throughout development, even at the early stages where the child is essentially nonverbal.

Language is seen to have the capacity to organize events and therefore produce new forms of behavior. Initially, language and activity occur relatively independent of one another and later language converges with activity which allows the child to use stimuli that are not overtly available to him. In this way, the child is able to overcome his previous dependence on perceptual cues. Labeling allows the child to single out an object from his perceptual field and thus, " . . . the immediacy of 'natural' perception is supplanted by a complex mediated process; as such speech becomes an essential part of the child's cognitive development" (Vygotsky, 1978, p. 32).

Vygotsky's (1962) research using classification tasks, looks at the role of language in concept formation. He and his associates found that children initially grouped objects on the basis of chance perceptible attributes, and then as they acquired some language, they began grouping according to one consistent perceptual attribute. This, he refers to as a "pseudo-concept". Only when the child is able to abstract and synthesize the attributes to form a novel thought, is the concept said to be a true concept.

Unlike Bruner, Vygotsky proposes that learning lags behind development, and therefore verbal instruction would not be effective in inducing learning if the child is not developmentally ready for it. Aside from this, the two theories have much in common. Both stress the importance of language in cognitive development, the dependence on perceptual cues for the young child and the relevance of socio-cultural factors.

CHAPTER III

SOCIAL LEARNING THEORY APPROACH TO CONCEPT REPRESENTATION AND ATTAINMENT

Social Learning Theory

Observational learning as outlined by Bandura (1977) is based on the premise " . . . that behavior is learned symbolically through central processing of response information before it is performed" (p. 35). That is, after observing a model's desired behavior, a person hypothesizes how the various components must be combined in order to produce the novel behavior and then attempts to perform the behavior. This is in contrast to traditional learning theory (e.g. Skinner, 1976) whereby imitation is said to be a passive, overt process which is governed directly through contingencies of reinforcement. According to social learning theory, reinforcement can facilitate learning but is not a necessary condition for its occurance (Bandura, 1977; Rosenthal & Zimmerman, 1978).

The necessary conditions for observational learning to occur are as follows: there must be attention to the modeled behavior; adequate representational process for retention; the physical and cognitive ability to perform the behavior; and sufficient incentive to warrant performance (Bandura, 1977). Of special interest to this research are the representational processes.

Representation allows for experiences to be retained for use as guides for future behavior. Bandura (1977) denotes two systems of representation: imaginal and verbal. Simple, immediate modeled behavior is generally acquired through imaginal representation, while more complex behavior depends on verbal representation. While Bandura's theory does not place a primary focus on the developmental aspects of representation, it does provide a brief account of how the representational processes evolve through childhood. Very young children must rely on immediate imitative learning because they have not yet developed the representation systems necessary for more abstract learning. Gradually, children learn to differentiate their own actions from those of others and begin to use a trial and error approach to match their behavior to that of the model. Roughly in the second year of life, children are said to attain imaginal representation, that is, they are no longer dependent upon overt trials of actions to imitate behavior. Although imaginal representation is discussed briefly, Bandura (1977) emphasizes that " . . . most modeled behavior is acquired and retained through the medium of verbal symbols" (p. 33).

Social learning techniques have been demonstrated to be effective in the acquisition of rule governed behaviors such as concept attainment, concept conservation and language. Rules for generating behavior with similar characteristics are acquired through the observation of common attributes in various modeled responses. The observer makes and constantly revises hypotheses regarding the relevant rule, based on further information until the rule has been induced.

Concept attainment tasks are very valuable for looking at rule governed behavior, because the tasks are novel, that is, the subjects do not have any prior experience with the rules involved. In this way, the primary experimenters in the field, namely, Rosenthal, Zimmerman and their associates have been able to look at the viability of social learning techniques, their generalizability and their effectiveness in enabling subjects to induce relevant rules.

Concept Attainment Research

Many studies have been done looking at the efficacy of social learning techniques such as silent or verbal modeling, giving instructions, explanations, rules and verbal labels either alone or in combination, with respect to concept acquisition.

Zimmerman and Kleefeld (1977) did a study to test the hypothesis that modeling would assist in teaching a seriation task to 5 year old children who had not yet learned how to seriate length. The children were assigned to one of three instructional groups: Group 1, where instruction was given by teachers who were trained to use modeling procedures and to give step by step descriptions as they related to the demonstration; Group 2, where instruction was given by teachers who were not trained to use modeling techniques;

and Group 3, who had no instruction. Results showed a marked increase in the number of correct seriation judgements made by the children with the trained teachers. These were significantly greater than those made by the children with untrained teachers and those in the control group. Further, the experimenters evaluated the different behaviors exhibited by the two types of teachers, as measured by the Teacher-Child Observation Instrument. Significant results were as follows: 1) trained teachers used demonstration and explanation jointly more than untrained teachers; 2) untrained teachers elicited more student response from asking questions; 3) trained teachers used a more consistent approach; and 4) trained teachers used more mnemonics. These researchers propose that the optimal technique for teaching is demonstration plus explanation and that explanation alone is actually negatively correlated with a child's learning.

This research is supported by a study done by Henderson, Swanson and Zimmerman (1975), where they used videotaped modeling to teach seriation to 3 to 5 year old Papago Indian children. They had two experimental conditions, one where the children viewed a video tape of a model who demonstrated and gave the rule for ordering the stimuli, and the other where the children watched a placebo tape. While there were no significant differences between the groups at pre-test, the experimental group scored significantly higher than the control group both immediately after training and at a post-test given 1 to 2 weeks later. Because this study did not compare other instructional techniques with the experimental group, it is difficult to draw many conclusions other than the fact that modeling plus giving the rule appears to be an effective way to teach seriation.

Both of the previous studies examined the effects of modeling, but there was always a verbal component involved in the form of rules or explanation. It is therefore difficult to come to any conclusions regarding the efficacy of modeling alone in teaching concepts to this age group. In an attempt to do this, Zimmerman and Jaffe (1977) conducted a study with 6 and 8 year olds, using various degrees of structured modeling. A conceptual sorting task was used where picture cards were made up of things that roll, rectangular things and pointed things. Three experimental conditions were used: 1) low structure, where the model simply placed the cards in front of the child already ordered in their respective groups; 2) intermediate structure, where the model looked at each card and then placed it in the proper group; and 3) high structure, where the model looked at the picture, pointed to its critical feature and then placed it in the proper group. Further, half of the children in each group were instructed to imitate what they had seen immediately after the model's presentation. Following training, each child was presented with new cards to test for transfer. Results showed a significant difference between groups, where high structure was significantly superior to the other two. There were no significant differences between the two age groups using either high structure or low structure. There was however, a significant difference between these two groups in the intermediate structure group, where the 8 year olds scored higher than the 6 year olds. Overt, immediate immitation failed to improve learning for either group. These researchers concluded that although the 6 year olds were able to learn the concept in the low and intermediate structured conditions, they were at a disadvantage in making inferences in a partially structured situation, and therefore the degree of structure in a model's demonstration was seen to be of critical importance. Unfortunately, this study failed to look at whether the children actually induced the conceptual rule governing the task.

Zimmerman and Rosenthal (1974) did a study to look at the effects of modeling and corrective feedback with 3 and 4 year old children. They used a "same-different" task, where the children had to show which of three items were the same or different and tell why. There were the following 4 conditions: 1) modeling, where the model would point to the correct response and give the accompanying rule which governed her choice; 2) corrective feedback, where the child was told whether he was right or wrong and given the reason; 3) modeling plus corrective feedback, where the child was given both types of assistance; and 4) controls. All of the children were given another set of stimuli, without any help, to test for generalization and then were retested after 1 week to assess retention. Results showed a significant effect for corrective feedback with respect to correct responses as well as reasons, whereas modeling was significant only with respect to reasons. Four year olds performed significantly better than 3 year olds. In addition, only the 4 year olds responded favourably to the corrective feedback through to generalization. They also found no significant difference between modeling and corrective feedback or the combination of the two, although all exceeded the control group. It is difficult to isolate the factors which led to concept acquisition, since all of the experimental conditions included rule provision. It could therefore be hypothesized that rule provision itself may have been the most important contributing factor.

A similar study was done by Zimmerman (1974) with 3, 4 and 5 year olds. The task entailed picking two objects out of four which were the same size, even though two out of the four were also the same object. Size was chosen as the relevant attribute because most of the children used object identity spontaneously as a choice. The children were assigned to one of four modeling conditions or a no-model control group. One group was modeling plus an explanation for the choice of size, whereas the other group received no explanation for the choice. Further, half of each group was given a token incentive for correct responses, although all children received corrective feedback, with or without incentives. Another set of stimuli were presented to test for generalization and then again 7 to 10 days later to test for retention. Results showed a significant main effect for phases where there was significant change from baseline to generalization and from baseline to retention. Explanations significantly assisted with superior performance on both generalization and retention. There was no main effect for the use of incentives. There was, however, a significant age effect, where 4 and 5 year olds did significantly better than the 3 year olds, and 4 and 5 year olds did not differ significantly. In the retention phase it was found that neither the 3 or 4 year olds could revert back to object identity after training. Zimmerman concludes that young children can learn and retain a conceptual grouping strategy on an unused dimension using social learning techniques. The fact that incentives were not significant is explained by their separation from a feedback function. The previous two studies have failed to look at the effects of either providing the rule or corrective feedback alone, without being part of a modeling condition.

Alford and Rosenthal (1973) studied the ability of Grade 2 subjects to learn a classification task, where the children were required to group objects on the basis of 2 dimensions; three different colours and three different objects. The experimental conditions consisted of silent modeling, where the experimenter modeled 15 possible correct responses, a low information code condition, where the model said, "I'll take one of these . . . ", a two category code, where the model said, "I'll take one of this colour . . . ", an attribute code, where the model labeled the objects on both colour and object name, and a control group. Further, each of the coding variations was done in the past tense as well (e.g. "I took one of these . . . "). In addition, they had a rule provision group, where a verbal summary of the concept was given. They found that the silent modeling group surpassed controls on both imitation and generalization. Modeling in the present tense was significantly more effective than modeling in the past tense, and for both types of modeling, performance in the imitation phase was greater than that in the generalization phase. All coding variations surpassed baseline, but there were significant declines from imitation to generalization for both the silent modeling and low code conditions, and there were no significant differences between the two conditions. On imitation, the two category code outperformed the attribute code. On generalization, however, both the two category code and the attribute code were not found to differ significantly. The researchers took this to suggest that specific labeling did not improve performance. The rule provision group did not differ significantly from the two stronger coding variations on performance. However, the equal utility of rule provision alone suggests that it may have been verbal organization of the task which was so effective. This result supports Bandura's hypothesis of both verbal and imaginal representation and that over time verbal coding comes to play a larger role in a child's cognitive processes.

Many other studies have shown similar results using social learning techniques to teach concepts to a wide variety of populations, namely, college students (Lassen, Rosenthal & White, 1979; Robert, White & Rosenthal, 1975), mentally handicapped adults (Rosenthal & Kellogg, 1973), and learning disabled children (Swanson, 1977; 1980; 1982).

Concept Conservation Research

In addition to the research on concept attainment, Rosenthal, Zimmerman and their associates have studied the implications of social learning techniques in terms of concept conservation as well. The primary focus of this research is to determine if in fact young children, not yet cognitively ready, according to Piagetian hypotheses, can be taught conservation through modeling procedures.

In an effort to compare Piaget's disequilibrium or cognitive conflict hypothesis with a social learning view, Zimmerman and Blom (1983) conducted a study with 6 year old preoperational children, using a weight conservation task with clay. Four experimental conditions were set up: consistent modeling, where 2 models gave identical conserving answers and verbalized the rule; conflict modeling, where one model gave conserving answers and the other disagreed; inconsistent modeling, where the two models each gave half nonconserving answers; and a control group. Further, each child was required to pick a picture of a face, which they felt was closest to how certain they were regarding their judgements. They had three choices; confident, uncertain and very uncertain. After the training phase, all children were given a post-test using different stimuli and then were tested again after one week using both sets of stimuli. Results showed that the consistent modeling group had significantly more conservation than all other groups, and that there were no significant differences between the conflict modeling, the inconsistent modeling or control group. They also found significantly higher conservation scores on delayed testing than on the post-testing. Path analyses were done to test for the effects of conflict on conservation, but no relationships were found. Zimmerman and Blom (1983) concluded that since the children were able to provide the rule with their conserving judgements under the modeling condition, even at the delayed post-test, that the children were indeed taught to conserve through a social learning paradigm.

That social learning techniques have been effective in teaching conservation has been shown with 4 and 6 year olds (Rosenthal & Zimmerman, 1972), with 4 year olds (Zimmerman

& Lanaro, 1974), with kindergarten children (Zimmerman & Rosenthal, 1974) and with Grade 1 children (Botvin & Murray, 1975). However, as with the previously cited literature on concept attainment, the researchers have often failed to isolate the effects of verbalization on the modeling procedures. It is therefore difficult to assume that modeling alone is responsible for any particular cognitive growth.

Related Research

The research of Whitehurst, Vasta and their associates has brough another dimension to social learning theory. Although their work is related directly to language and not concept acquisition, it has led to some relevant implications for the present research.

Whitehurst and Vasta (1975) propose a three stage process for the acquisition of language, known as the CIP (Comprehension-Imitation-Production) hypothesis. In the traditional view of language acquisition, it is felt that imitation precedes comprehension. Whitehurst and Vasta, on the other hand, propose that imitation follows comprehension, that is, the child is first able to discriminate the relationship between a particular speech characteristic and the specific domain to which it refers. Differential reinforcement is seen to be an important factor in achieving comprehension, but it is only one variable in the process.

The second stage of the language acquisition process is imitation. This is not direct copying or mimicry, but instead selective imitation, where _any_ aspect of a model's speech is matched by that of the child. This allows for the child to imitate the structure of a model's speech while maintaining different content. Modeling is therefore seen to be an effective means to teach language if and only if " . . . the child brings to the modeling episode some rudimentary comprehension of the modeled form or unless the modeling episode is itself designed to promote comprehension" (Whitehurst, 1977, p. 24).

Morgulas and Zimmerman (1979) undertook a study to determine whether there was a correlation between comprehension and selective imitation. They used four and five year olds who were pre-tested for their comprehension of passive sentences, and were divided according to the results into groups of high, intermediate and low comprehenders. Two series of action pictures were used for the pre-test and post-test stimuli. Any child who demonstrated the correct usage of a passive sentence during the pre-test was excluded from the study. The remainder of the children were divided between a modeling and a control group. In the modeling group, the experimenter modeled 6 correct sentences pointing to the recipient of the action on each card and then he and the child alternated until the child had responded to 20 cards. Children in the control group were not given any of the demonstrations, but were shown the cards with the experimenter pointing to the recipient of the action. Results demonstrated a significant correlation between the scores on comprehension and those on the post-test for those children in the modeling group, where high comprehenders scored significantly higher than the others. They also found that high, intermediate and low comprehenders in the modeling group scored significantly higher than their counterparts in the control group. Morgulas and Zimmerman found their results supported the CIP hypothesis in terms of the relationship between comprehension and consequent selective imitation through modeling of a particular syntactic form. They also suggest that although good comprehension enhanced imitation, not all good comprehenders selectively imitated. These researchers propose that before any final conclusions can be reached, the experimental design must be altered so that they can be sure of the subject's prior level of comprehension.

Numerous studies are available which support the CIP formulation of Whitehurst and Vasta (e.g., Whitehurst & Novak, 1973; Whitehurst, Ironsmith & Goldfein, 1974; Whitehurst, 1976; Whitehurst, 1977). Clark and Hecht (1983) conclude that:

> . . . one essential part of acquiring language is the coordination of what children produce with what they may understand. This coordination is effected by watching certain parts of the memory representations children set up for production and what they may have already represented for comprehension. What they understand, then, sets the standard for what they are trying to produce. (p. 342)

It seems likely that such a formulation could be adapted to the previously discussed theory of concept attainment and conservation. It is possible that some level of prior understanding must be present in order for observational learning to take place. Numerous studies (e.g. Rosser & Brody, 1981; MacFadyen, 1985; Zimmerman & Jaffe, 1977; Zimmerman & Rosenthal, 1974; Zimmerman, 1974) have demonstrated that younger children are not as receptive to modeling procedures as older children. Unfortunately, little has been noted in the research regarding age differences, although it could be hypothesized in line with the CIP literature, that these children have not yet attained sufficient comprehension in order for them to optimally benefit from a modeling paradigm.

<u>Social Learning Research with Developmental Implications</u>

Although most of the social learning research fails to try to explain developmental differences, there are some studies which make an effort to do so.

Rosser and Brody (1981) carried out a study looking at seriation of length, where 7 dowels ranging in length from 3 to 6 inches were used, with 3, 4 and 5 year olds. The children were assigned to one of four experimental conditions: 1) High information modeling, where the experimenter modeled the correct response, provided verbal mediation (e.g. "I'll take the longest and put it here . . . "), and also gave the verbal rule (e.g. "Now this is in order from longest to shortest. Things are in order when they go down like stairs".); 2) Medium information modeling, where the verbal mediation was eliminated but the rest remained the same; 3) Low information modeling, where only a verbal statement was presented with the modeled behavior (e.g., "Now this is in order from longest to shortest".); and 4) control group. Following training, all children were exposed to three different transfer tasks. Results showed that the high information group did significantly better than either the medium or low information group, which did not differ significantly with one another, although both exceeded the control group. They also found that the 5 year olds did significantly better than the 4 year olds, who in turn did better than the 3 year olds. Rosser and Brody concluded that the performance of children at this age level is significantly enhanced by the provision of the rule plus verbal mediation and that in fact, they require this type of instruction in order for them to generalize to other related tasks.

A study which perhaps is most relevant to the present research is an experiment done by MacFadyen (1985), with Grade 1 and 4 children. S's were required to learn the following three variations of a two dimensional concept: Concept 1, where no verbal labels were available (e.g., 3 different colours and object identities, which were difficult to code verbally); Concept 2, where verbal labels were available (e.g., 3 different colours and object identities which were easy to label); and Concept 3, where verbal labels were available, but one of the dimensions relied on a relationship between objects (e.g., 3 different colours and " . . . a different number of objects the same"). The children were assigned to either a silent modeling condition, a rule repetition condition, where the relevant rule was repeated twice, or a control group. After the concept acquisition task, all of the children were given a generalization task. Results showed a main effect for grade, where Grade 4 S's scored significantly higher than did those in Grade 1, on both acquisition and generalization. Rule repetition was found to be more effective than modeling, particularly for the Grade 1 S's on acquisition and in fact virtually no generalization occurred for the younger children in the modeling condition. In terms of the concept types, on acquisition Concept 3 was more difficult to attain than Concept 1 or 2, especially for those S's in the modeling condition. In order to test whether the children had fully induced the concept, they were required to state the rule after the generalization task. Results showed that for both groups, S's in the rule repetition condition were more likely to be able to state the rule. MacFadyen concluded that for younger children, the addition of verbal mediators, such as the rule, provides them with the representational processes required to induce a two dimensional conceptual rule. Although the older children also benefited by the addition of the rule, they did not require it in order to generalize because they presumably have more well developed verbal representation.

The preceeding studies are fairly relevant to the present research which, while using a social learning paradigm, takes a special interest in developmental implications as well.

CHAPTER IV

EXPERIMENTAL METHOD AND DESIGN

Method

Subjects

The sample consisted of 80 children enrolled in the Catholic School System in Calgary. Equal number of boys and girls were used from both E.C.S. and Grade 1 classes. The age range for each of the two groups was 5-0 to 5-11 years, and 6-0 to 6-11 years respectively. Other criteria used for inclusion in the study were as follows: a standard score between 85 and 115 on the Peabody Picture Vocabulary Test - Revised (Dunn & Dunn, 1981), average achievement and progress as indicated by school records, and no evidence of any sensory or motor handicaps.

Subjects were drawn randomly from two middle class schools, within the confines of the selection criteria. The Peabody Picture Vocabulary Test - Revised (Form M) was administered to all children. Those S's who had standard scores between 85 and 115 were then individually screened to ensure that they were able to describe the shapes and colours used in the study. In addition, each child was given the Pictorial Similarities and Differences sub-test at the 4-6 year level of the Stanford-Binet to see if they had attained the concept "different". Any child who did not meet these requirements was eliminated from the study.

Forty E.C.S. and 40 Grade 1 children were randomly assigned to each of 8 experimental conditions in a 2 (sex) x 2 (grade) x 4 (methods of instruction) design, with repeated measures at baseline, acquisition, and generalization.

Measuring Instruments

a) Intelligence Measures

Because this study was designed to look at normal or average developmental trends in concept attainment, an assessment of intelligence was required to ensure that all of the children participating in the study fell within the average range. The Peabody Picture Vocabulary Test - Revised (PPVT-R) was chosen for several reasons. First, since there are no available group tests of intelligence which are reliable for children ranging in age from 5-0 to 6-11 years, an individual assessment had to be used. Secondly, most individual tests of intelligence (e.g. McCarthy Scales of Children's Abilities, Stanford-Binet Intelligence Scale and the Wechsler Preschool and Primary Scale of Intelligence) are extremely lengthy and time consuming to administer. The PPVT-R, on the other hand, requires only about 10 minutes. Finally, the PPVT-R measures vocabulary, and vocabulary is the single best indicator of intelligence (Maloney & Ward, 1976). Concurrent validity data is scarce on the PPVT-R, but is quite extensive on the PPVT. The revisions to the PPVT were mostly superficial in nature, so it should be safe to assume that the validity data would be a close approximation of that for the PPVT-R. In a review of studies comparing the Stanford-Binet to the PPVT, the correlations ranged from 0.15 to 0.88, with a median correlation of 0.62 (Dunn & Dunn, 1981). The correlations between the WISC full scale and the PPVT ranged from -0.16 to 0.91, with a median correlation of 0.64. The verbal scale of the WISC and the PPVT correlations ranged from 0.04 to 0.88, with a median of 0.66. These correlations provide data on the validity of the PPVT.

The reported reliability data suggests a high degree of consistency for the PPVT-R, with split-half correlations on Form M ranging from 0.61 to 0.86, with a median of 0.81, and those comparing Form M and Form L ranging from 0.73 to 0.91, with a median of 0.82.

b) Concept Attainment Measures

A two-dimensional concept attainment task was used where three objects were clustered on the basis of three different colours and three different geometrical shapes. In previous studies, it has been found that a colour x object task was of sufficient difficulty for Grade 1 and Grade 4 students (MacFadyen, 1985), and Grade 2 students (Alford & Rosenthal, 1973). Since Melkman, Tversky and Baratz (1981) used a colour x form (shape) grouping task successfully with 4 and 5 year olds, it was thought that a colour x shape concept attainment task would be appropriate for the 5 and 6 year olds in the present study.

Two separate sets of materials were used, each displaying three different shapes and three different colours. The first set, which was used for both the baseline and acquisition phases, contained circles, stars and squares, in red, yellow and black (see Figure 2). The second set, used for the generalization phase, contained triangles, rectangles and diamonds, in green, orange and brown (see Figure 3).

Since the tasks involved a combination of three attribute values on two dimensions (colour and shape), there were nine possible combinations for both the acquisition and generalization materials. In order to facilitate freedom of choice, there were four copies of each attribute combination to choose from.

Since three choices were always involved, a white cardboard mat with three X's was placed in front of the child during all three phases, to act as a cue. Depending on which phase of the experiment was being carried out, either the acquisition (baseline and acquisition phases) or the generalization materials (generalization phase) were spread out in front of the child in random order so that there would be a clear view of all of the shapes and colours available. After each trial, the shapes were cleared off the mat and mixed up with those on the table to reduce the possibility of cluster repetitions.

The concept of "three different shapes and three dif-

FIGURE 2

Baseline and Acquisition Attribute Combinations

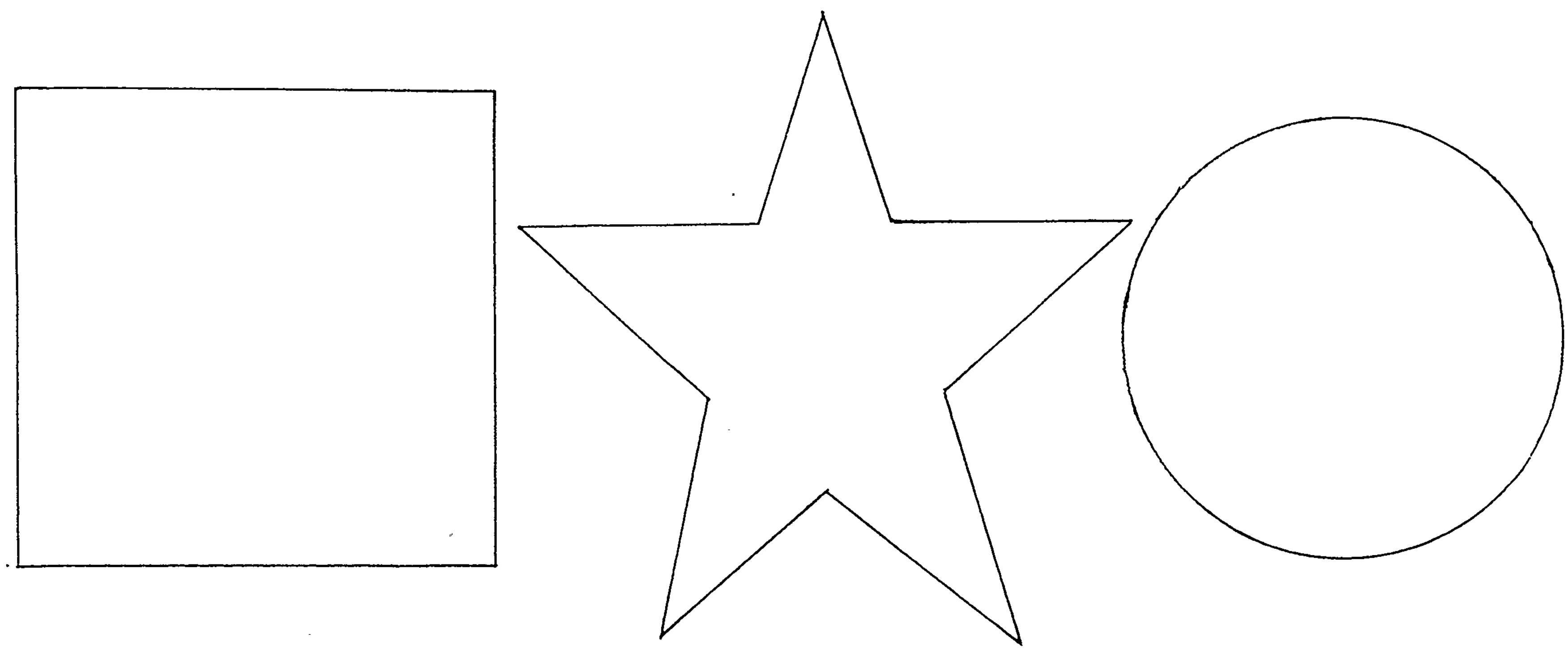
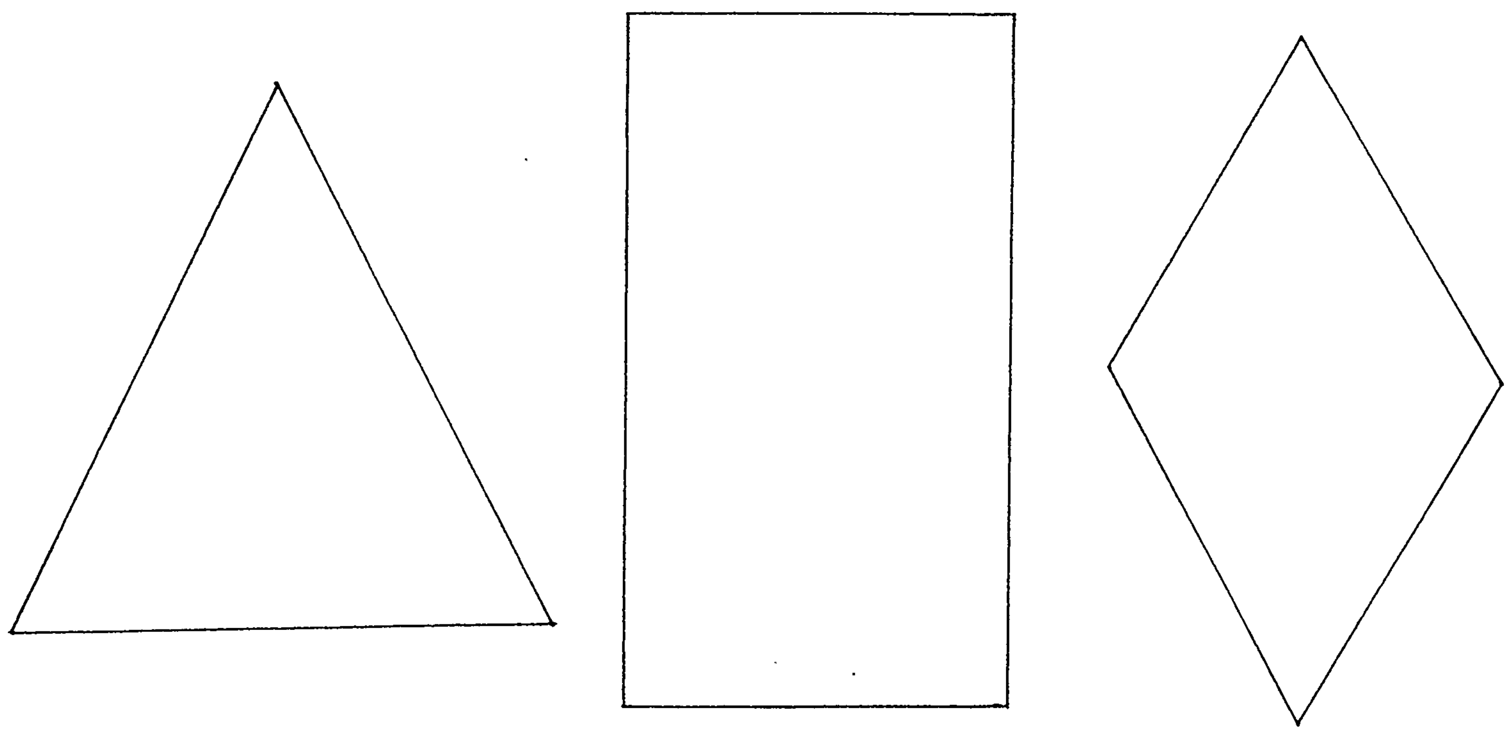


FIGURE 3

Generalization Attribute Combinations



ferent colours" was not considered to be attained unless the child used the rule in the generalization phase as well as the acquisition phase.

Procedure

Each child was taken individually from the classroom and greeted with:

> Hi (first name of child), my name is Kathy, and I'd like to teach you how to play a game. Is that okay with you?

All of the children consented, were taken to a testing room and were seated at a table across from E. Each S was then told:

> Before I teach you how to play the game, there are a few things I'd like you to do for me.

The PPVT-R and the Similarities and Differences sub-test were then administered and scored. Each S was then required to label all of the shapes and colours used in both the concept acquisition and generalization tasks. Seven children did not meet the criteria for inclusion in the study and were dropped. These children were given an abbreviated version of the concept acquisition phase using rule repetition to avoid any problems when they got together with other children who had participated in the study. These seven children were replaced with seven others who met the criteria to ensure that the original number of subjects was maintained.

The children were then randomly assigned to either the modeling (M), rule repetition (RR), modeling plus rule repetition (M+RR) or control (C) condition.

Both the baseline and acquisition phases required 18 trials. Prior to the baseline phase, all S's were shown six of the attribute combinations in order to familiarize themselves with the acquisition materials and were told:

> I want to see if you can play this game the right way. There are coloured shapes here in front of you. You see, there are circles, stars and squares. They are red, yellow and black (E indicates the shapes and colours). I want you to pick three shapes. There is a right way to pick the shapes. See if you can figure out the right way. Please put the shapes on the X's on the mat. I won't tell you if you are right. You must decide for yourself.

Before each of the remaining 17 trials, E said:

> Let's try it again. See if you can figure out the right way to pick the shapes.

In the modeling (M) condition, S's observed the model display 2 different clusters of the acquisition materials prior to each of the 18 acquisition trials. This allowed for all 36 possible correct combinations to be modeled in random order. Each cluster was exposed for the same amount of time required to state the rule. S's were told:

> Now I am going to teach you how to play the game the right way. We will use the same shapes as before. Watch carefully and I will show you how to pick the shapes the right way. I will show you two times and then you will have a turn to pick the shapes the right way.

After the first 2 clusters were modeled, they were told:

> Now look carefully and pick the shapes the right way. I won't tell you if you are right. You must decide for yourself.

Before each of the remaining 17 trials, S's were told:

> I'll show you again how to pick the shapes the right way (E demonstrates as before).

For the rule repetition (RR) condition, S's were told:

> Now I am going to teach you how to play the game the right way. We will use the same shapes as before. Listen carefully and I will tell you how to pick the shapes the right way. I will tell you two times and then you will have a turn to pick the shapes the right way.
>
> I want you to pick three different shapes and make sure that each shape is a different colour. I'll say it again. Pick three different shapes and make sure that each shape is a different colour. Now look carefully, and pick the shapes the right way. I won't tell you if you are right. You must decide for yourself.

Before each of the remaining 17 trials, S's were told:

> I'll tell you again how to pick the shapes the right way (E repeats the rule twice as before).

In the modeling plus rule repetition (M+RR) condition, S's were given the same instructions as in RR, but while the rule was being stated, they were shown the same attribute combinations as in M, simultaneously.

The baseline procedure was repeated for those in the control (C) condition.

After the children had completed the acquisition trials, the acquisition materials were replaced with those for the generalization phase. All of the S's were familiarized with six of the attribute combinations as before, and were instructed as follows:

> Now here are some more shapes. You see, there are rectangles, triangles and diamonds. They are brown, orange and green. I want you to

> pick these shapes the same way I showed you (M)/Itold you (RR, M+RR)/as you did (C), before.

Prior to each of the remaining trials, S's were told:

> I want you to pick some more shapes the way I showed you (M)/I told you (RR, M+RR)/as you did (C), before.

Generalization trials were discontinued after either 5 consecutive correct responses or 18 trials. In order to determine whether S's had induced the combinatory rule, each child was asked:

> Now, let's pretend that you are going to teach me how to play this game the right way. What should I do? What shapes should I pick? Why? How do I know which are the right shapes?

Each child was then thanked and returned to his/her classroom.

Statistical Analysis

Analysis of Concept Attainment Scores

A three way analysis of variance with repeated measures (ANOVA) was chosen as the statistical procedure to analyze concept attainment scores. This method of analysis is consistent with that of most researchers in this area (e.g. Alford & Rosenthal, 1973; Henderson, Swanson & Zimmerman, 1975; Robert, White & Rosenthal, 1975; Rosenthal, Moore, Dorfman & Nelson, 1971; Rosser & Brody, 1981). The design of the study was 2 (sex) x 2 (grade) x 4 (methods of instruction), with three repeated measures from baseline, to concept acquisition, to concept generalization.

This procedure was done using BMDP2V, a computer program designed to carry out analyses of variance and covariance with repeated measures. This program provides both an ANOVA table where the independent variables of sex, grade, and method of instruction over the three phases of concept attainment, are considered relative to the grand mean for all of these conditions combined, as well as ANOVA tables for each of the three repeated measures separately, relative to its own mean.

The structural model on which the analysis was based is as follows: $X_{ijklm} = \mu + \alpha_i + \beta_j + \gamma_k + \alpha\beta_{ij} + \alpha\gamma_{ik} + \beta\gamma_{jk} + \alpha\beta\gamma_{ijk} + \pi_{m(ijk)} + y_l + \alpha y_{il} + \beta y_{jl} + \gamma y_{kl} + \alpha\beta y_{ijl} + \alpha\gamma y_{ikl} + \beta\gamma y_{jkl} + \alpha\gamma\beta y_{ijkl} + y\pi_{lm(ijk)} + \varepsilon_{o(ijklm)}$

Where, i = 1,2 levels of grade

j = 1,2 levels of sex

k = 1,4 levels of instruction

l = 1,3 repeated measures on phases of concept attainment

And, μ = the general mean for each independent variable

α_i = the scores for grade

β_j = the scores for sex

γ_k = the scores for methods of instruction

$\alpha\beta_{ij}$ = the scores for grade X sex interaction

$\alpha\gamma_{ik}$ = the scores for grade X methods of instruction interaction

$\beta\gamma_{jk}$ = the scores for sex X methods of instruction interaction

$\alpha\beta\gamma_{ijk}$ = the scores for grade X sex X methods of instruction interaction

$\pi_{m(ijk)}$ = residual error for the independent variables

y_l = the scores for each phase of concept attainment (baseline, acquisition, generalization)

αy_{il} = the scores for grade at each phase of concept attainment

βy_{jl} = the scores for sex at each phase of concept attainment

γy_{kl} = the scores for methods of instruction at each phase of concept attainment

$\alpha\beta y_{ijl}$ = the scores for grade X sex interaction at each phase of concept attainment

$\alpha\gamma y_{ikl}$ = the scores for grade X methods of instruction at each phase of concept attainment

$\beta\gamma y_{jkl}$ = the scores for sex X methods of instruction at each phase of concept attainment

$\alpha\beta\gamma y_{ijkl}$ = the scores for grade X sex X methods of instruction at each phase of concept attainment

$y\pi_{lm(ijk)}$ = residual error for phases of concept attainment

$\varepsilon_{\alpha(ijklm)}$ = error term

Analysis of the Ability to State the Rule

After the generalization phase, all S's were required to state the combinatory rule for the acquisition and generalization materials. In order to get credit for stating the rule, it was also necessary for S's to be able to demonstrate that they could apply it correctly by combining all different values on each of the two relevant attributes.

In order to analyze this data in more detail, each S's rule statement was assigned one of the following dummy variables: 0, where S's got neither of the relevant attributes; 1, where S's got colour alone; 2, where S's got shape alone;

and 3, where S's got both relevant attributes.

Two x^2 analyses were done; one to test the null hypothesis that there were no differences between E.C.S. and Grade 1 S's in their ability to state the rule, and the other to test the null hypothesis that there were no differences in the effects of the methods of instruction on S's ability to state the rule. It was also of interest to see if there was a relationship between grade and/or methods of instruction and the frequency of stating only colour or shape as the relevant attribute.

Further, it was decided to test these same hypotheses simply on the basis of whether S's could or could not state the rule, in case the previous analyses eliminated the possibility of significance.

Analysis of Copying Scores

A S's response was only considered "copied" if it was an exact match of the modeled response. For example, if E presented a red star, a black square and a yellow circle, a direct copy would be those particular shapes in that order. Initially a t test was done comparing the copying scores of those S's in the modeling alone, and modeling plus rule repetition conditions to test the null hypothesis that there was no significant difference between the two groups in the amount of direct copying.

A second t test was done pooling both conditions to test the null hypothesis that there was no difference between the E.C.S. and Grade 1 S's in the amount of direct copying.

With all copying scores together, a third t test was done to compare them with the possibility of getting a copied response by chance. This was done to test the null hypothesis that there was no significant difference between the S's scores in the two modeling conditions and those which could have been attained by chance.

The results from these analyses are presented in Chapter V.

Hypotheses

The following hypotheses were generated as a result of the literature review.

Concept Attainment Across Phases

Hypothesis 1: There will not be a significant main effect for grade, where Grade 1 S's will not score significantly higher than E.C.S. S's when the phases are combined.

Hypothesis 2: There will be a main effect for methods of instruction, where scores on both RR and M+RR will be significantly higher than those on M, which will be significantly higher than those on C.

Hypothesis 3: There will be a main effect for phases of concept attainment, where scores on acquisition will be significantly higher than those on either generalization or baseline, and scores on generalization will be significantly higher than those on baseline.

Hypothesis 4: There will be an interaction effect for phases of concept attainment x condition, where there will be generalization only for those S's in RR or M+RR.

Concept Acquisition Scores

Hypothesis 5: There will not be a main effect for grade, where Grade 1 S's will not have significantly higher concept acquisition scores than E.C.S. S's.

Hypothesis 6: There will be a main effect for methods of instruction, where acquisition scores on RR and M+RR will be significantly higher than those on M, which will be significantly higher than those on C.

Concept Generalization Scores

Hypothesis 7: There will not be a main effect for grade, where Grade 1 S's will not have significantly higher concept generalization scores than E.C.S. S's.

Hypothesis 8: There will be a significant main effect for methods of instruction, where generalization scores on both RR and M+RR will be significantly higher than scores on M or C, which will not differ significantly.

Rule Attainment

Hypothesis 9: There will be no significant differences between Grade 1 and E.C.S. S's in their ability to state the rule.

Hypothesis 10: S's in RR and M+RR will be able to state the rule significantly more often than S's in M, and S's in M will not differ significantly from those in C.

Copying Scores

Hypothesis 11: S's in M or M+RR will give direct copied responses significantly more often than chance.

These hypotheses are generated from the developmental position of Bruner which would postulate that:

1. since both E.C.S. and Grade 1 children are in the "transitional" stage in the development of representational processes, there should be no significant difference between them in their ability to spontaneously organize a two dimensional concept through verbal representation, or in their ability to benefit from instruction which does this organizing for them, and;
2. the important component in the instruction is the provision of the verbal rule which should allow both the E.C.S. and Grade 1 children to attain the concept significantly better than the modeling

instruction which relies on the children's ability to spontaneously generate the appropriate verbal representation.

CHAPTER V

RESULTS

Analysis of Concept Attainment Scores

A three way ANOVA with repeated measures was carried out using a 2 (grade) x 2 (sex) x 4 (methods of instruction), repeated measures from baseline to acquisition to generalization design. This analysis showed a number of main effects and interactions significant at the 0.05 level or less (see Table 1). These results are as follows:

1. A significant main effect for methods of instruction, where $F(3,64) = 34.11$, $p < .0001$;
2. A significant main effect for phases of concept attainment, where $F(2,128) = 114.23$, $p < .0001$;
3. A significant interaction effect between methods of instruction and phases of concept attainment, where $F(6,128) = 20.45$, $p < .0001$. Figure 4 indicates that for the control group, acquisition and generalization scores are significantly lower than those for RR, M, and M+RR. Figure 5 demonstrates that there is no significant difference between E.C.S. and Grade 1 S's across the three phases for M and C, but Grade 1 S's did score higher than E.C.S. S's on RR and M+RR.

Since sex was not found to be significant ($F(1,64) =$

TABLE 1

Summary ANOVA Table for Grade x Sex x Methods of Instruction with Three Repeated Measures

SOURCE	SUMS OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE	F RATIO
Grade (g)	84.02	1	84.02	2.66
Sex (s)	19.27	1	19.27	0.61
Methods of Instruction (I)	3227.63	3	1075.88	34.11*
g x s	22.81	1	22.81	0.72
g x I	168.40	3	56.14	1.78
s x I	33.70	3	11.23	0.36
g x s x I	31.48	3	10.49	0.33
Error	2018.40	64	31.54	
REPEATED MEASURES				
Phases of Concept Attainment (B)	2890.01	2	1445.0	114.23*
B x g	16.36	2	8.18	0.65
B x s	26.01	2	13.00	1.03
B x I	1551.89	6	258.65	20.45*
B x g x s	54.16	2	27.08	2.14
B x g x I	71.21	6	11.87	0.94
B x s x I	72.43	6	12.07	0.95
B x g x s x I	62.74	6	10.46	0.83
Error	1619.20	128	12.65	

Where B refers to the phases of concept attainment, namely; baseline, acquisition and generalization.

*$p < 0.0001$

FIGURE 4

Interaction Effect Between Methods of Instruction and Phases of Concept Attainment with Grades Combined

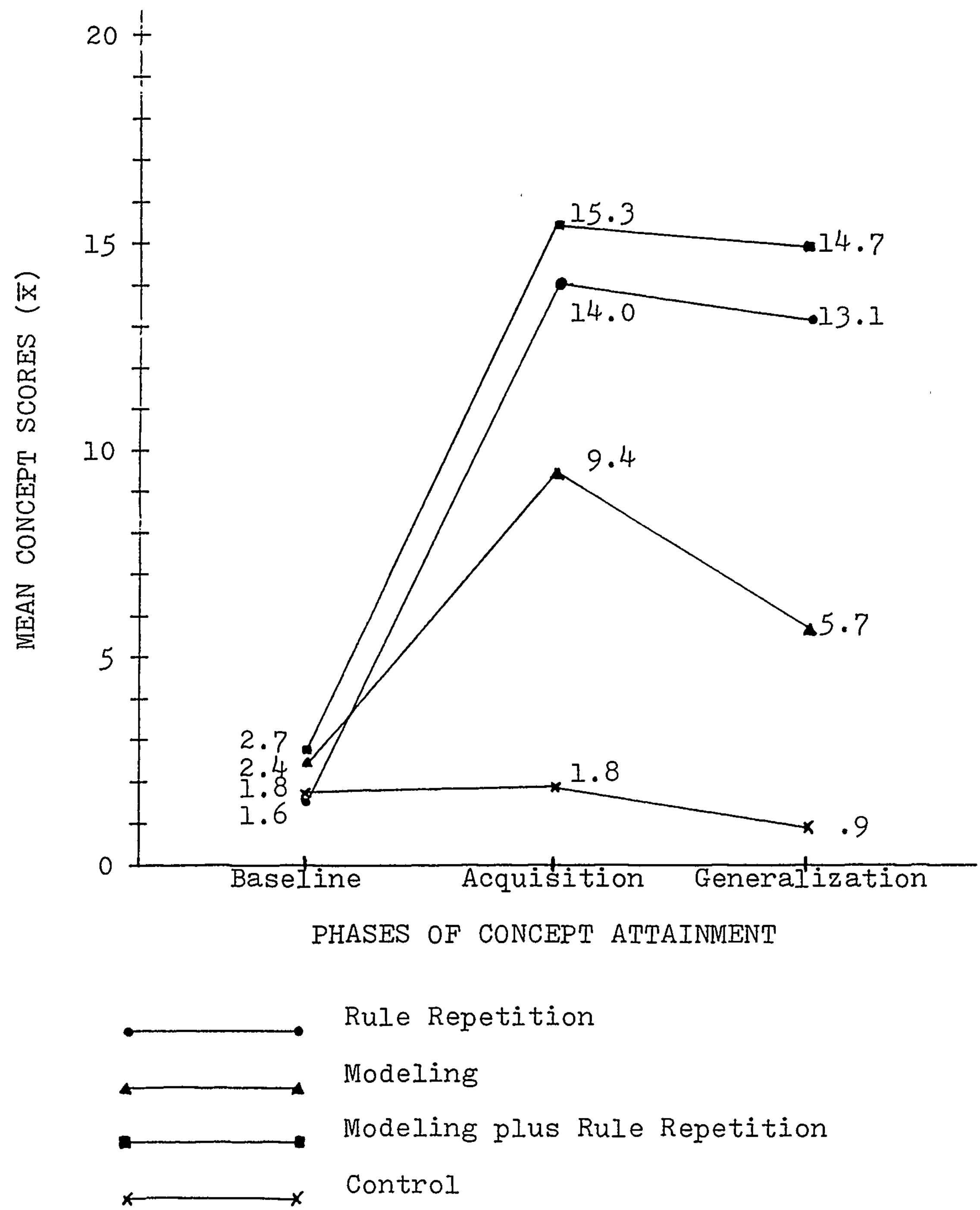


FIGURE 5

Interaction Effect Between Methods of Instruction and Phases of Concept Attainment for E.C.S. and Grade 1 Separately

Figure 5a -- Rule Repetition

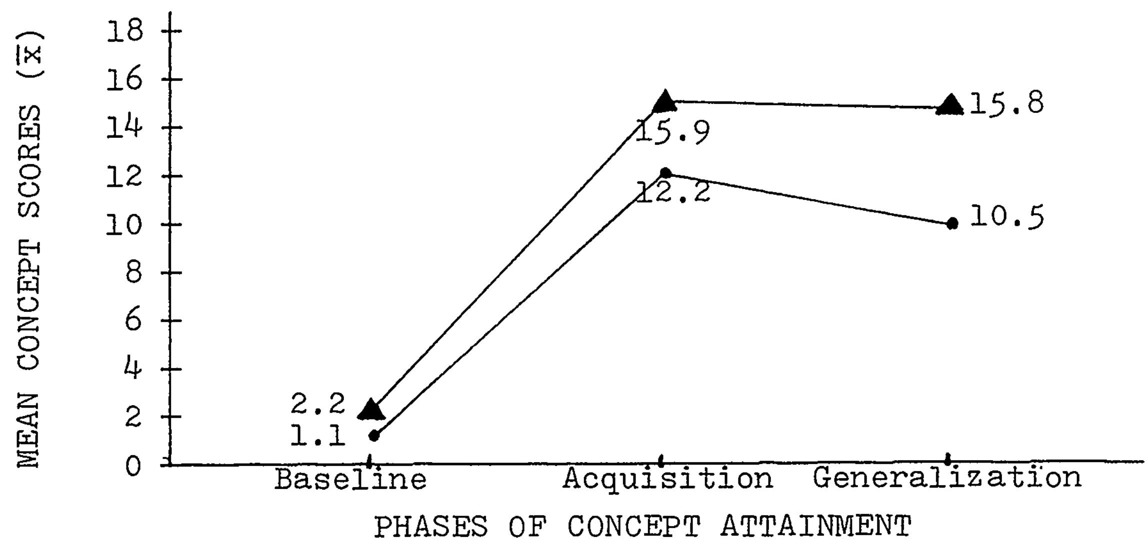


Figure 5b -- Modeling

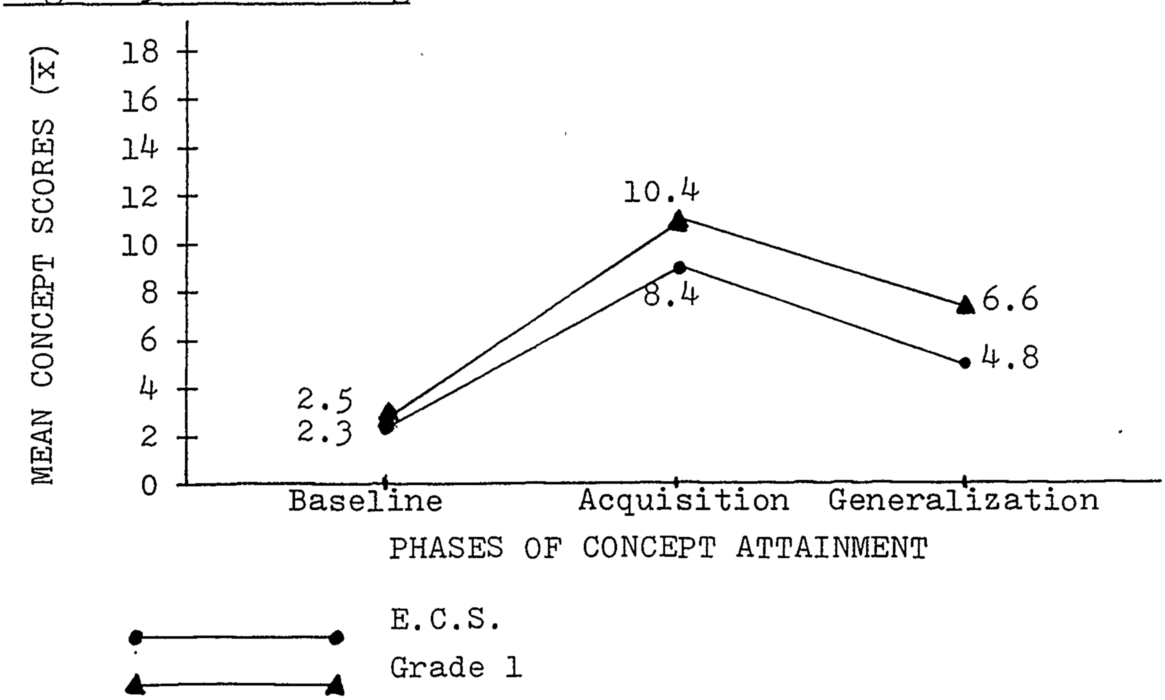


Figure 5 (continued)

Figure 5c -- Modeling plus Rule Repetition

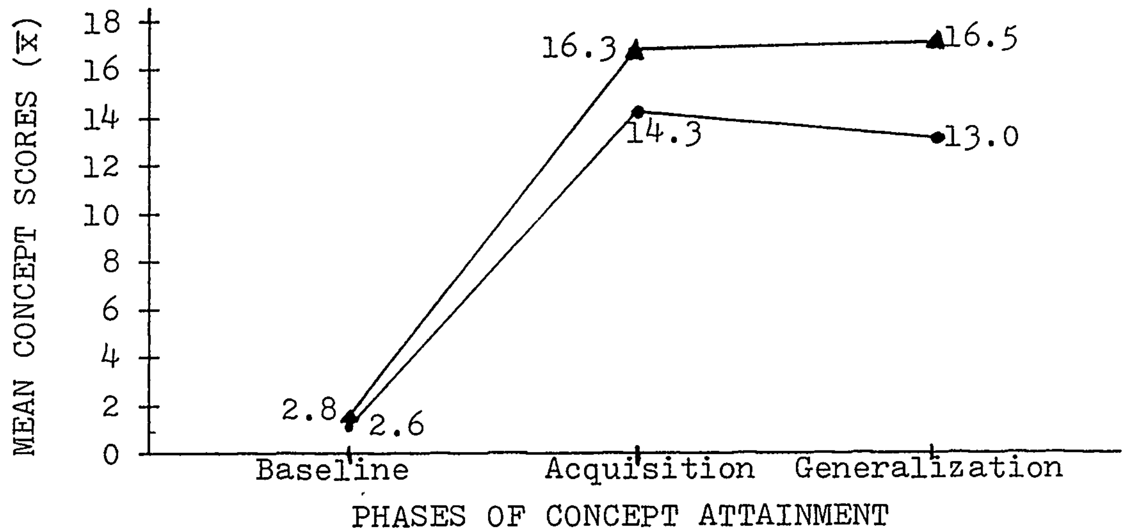
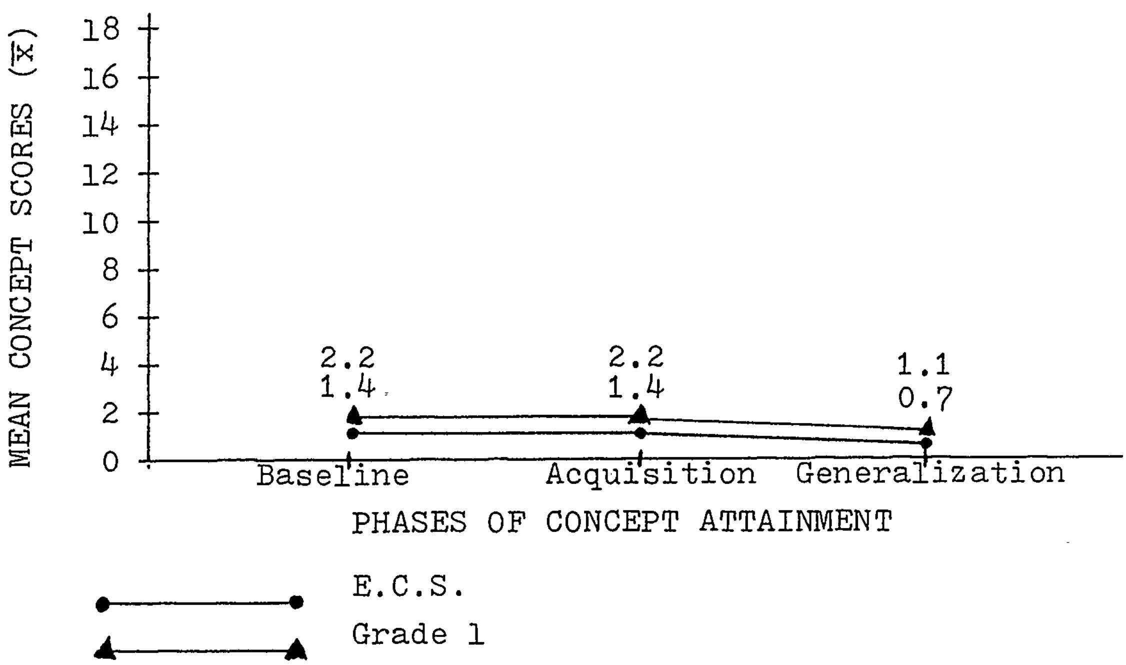


Figure 5d -- Control



0.61, $p < .44$), a second ANOVA was done without sex to determine whether this would make any significant differences with respect to the results. The structural model was therefore reduced to: $X_{iklm} = \mu + \alpha_i + \gamma_k + \alpha\gamma_{ik} + \pi_{m(ik)} + y_l + \alpha y_{il} + \gamma y_{kl} + \alpha\gamma y_{ikl} + y\pi_{lm(ik)} + \varepsilon_{o(iklm)}$

The data was reanalyzed using this reduced structural model with sex omitted as an independent variable. The means and standard deviations are presented in Table 2. The summary ANOVA table (see Table 3) indicates that although the F ratios are somewhat higher, the results remained consistent with those from the preliminary analysis.

Table 4 presents a summary of the individual ANOVA tables for each phase of concept attainment (i.e. baseline, acquisition, and generalization). Significant results from these individual analyses are as follows:

1. A significant main effect for methods of instruction on acquisition, where $F(3,72) = 34.08$, $p < .0001$;
2. A significant main effect for methods of instruction on generalization, where $F(3,72) = 27.03$, $p < .0001$.

<u>Post Hoc Analyses</u>

The significant effects derived from these analyses required further comparisons to determine more specific results, therefore, several Tukey tests were employed to do the post hoc analyses. The following formula (Hopkins &

TABLE 2

Means ($\bar{x}$) and Standard Deviations (SD) for Baseline, Acquisition and Generalization with Sex Omitted

TREATMENT COMBINATIONS	BASELINE		ACQUISITION		GENERALIZATION	
GRADE/METHOD OF INSTRUCTION	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
E.C.S., Rule Repetition	1.10	1.29	12.20	7.69	10.50	8.90
E.C.S., Modeling	2.30	1.06	10.40	6.29	6.60	7.96
E.C.S., Modeling & Rule Repetition	2.60	0.97	14.30	4.37	13.00	7.40
E.C.S., Control	1.40	1.08	1.40	1.08	0.70	0.82
Grade 1, Role Repetition	2.20	2.49	15.90	4.93	15.80	4.24
Grade 1, Modeling	2.50	0.97	8.40	5.19	4.80	3.90
Grade 1, Modeling & Rule Repetition	2.80	1.39	16.30	1.83	16.50	4.09
Grade 1, Control	2.20	1.32	2.20	1.32	1.10	0.74

TABLE 3

Summary ANOVA Table for Grade x Methods of Instruction with Three Repeated Measures

SOURCE	SUMS OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE	F RATIO
Grade (g)	84.02	1	84.02	2.85
Methods of Instruction (I)	3227.63	3	1075.88	36.44*
g x I	168.42	3	56.14	1.90
Error	2125.67	72	29.52	
REPEATED MEASURES				
Phases of Concept Attainment (B)	2890.01	2	1445.00	113.42*
B x g	16.36	2	8.18	0.64
B x I	1551.89	6	258.65	20.30*
B x g x I	71.21	6	11.87	0.93
Error	1834.53	144	12.74	

Where B refers to the phases of concept attainment; namely, baseline, acquisition and generalization.

*$p < 0.0001$

TABLE 4

Summary of Individual ANOVA Tables
for Baseline, Acquisition and Generalization

BASELINE

SOURCE	SUMS OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE	F RATIO
Grade (g)	6.61	1	6.61	3.37
Method of Instruction (I)	14.74	3	4.91	2.51
g x I	3.04	3	1.01	0.52
Error	141.10	72	1.96	

ACQUISITION

SOURCE	SUMS OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE	F RATIO
Grade (g)	25.31	1	25.31	1.16
Method of Instruction (I)	2240.34	3	746.78	34.08*
g x I	86.34	3	28.78	1.31
Error	1577.50	72	21.91	

GENERALIZATION

SOURCE	SUMS OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE	F RATIO
Grade (g)	68.45	1	68.45	2.20
Method of Instruction (I)	2524.45	3	841.48	27.03*
g x I	150.25	3	50.08	1.16
Error	2241.60	72	31.13	

*$p < 0.0001$

Glass, 1978) was used: $q = \frac{|\bar{x}_i - \bar{x}_j|}{\sqrt{MS_w/n}}$

From the significant results found on the ANOVA with repeated measures on baseline, acquisition and generalization, the following can be stated as a result of the application of the Tukey method:

1. There is a significant difference between RR and C, where S's in RR scored significantly higher than those in C ($q(4,72) = 13.31$, $p < .01$).
2. There is a significant difference between M+RR and C, where S's in M+RR scored significantly higher than those in C ($q(4,72) = 15.33$, $p < .01$).
3. There is a significant difference between RR and M, where S's in RR scored significantly higher than those in M ($q(4,72) = 6.26$, $p < .01$).
4. There is a significant difference between M+RR and M, where S's in M+RR scored significantly higher than those in M ($q(4,72) = 8.28$, $p < .01$).
5. There is a significant difference between M and C, where S's in M scored significantly higher than those in C ($q(4,72) = 7.05$, $p < .01$).
6. There is a significant difference between the repeated measures of phases of concept attainment, where baseline scores were significantly lower than acquisition scores ($q(3,144) = 20.05$, $p < .01$), and generalization scores ($q(3,144) = 16.27$, $p < .01$).

Acquisition scores were significantly higher than generalization scores ($q(3,144) = 3.78$, $p < .01$).

The significant interaction effect between methods of instruction and phases of concept attainment is taken into account with the post hoc analyses done for the individual ANOVAs, which are as follows:

1. On acquisition, scores in RR were significantly higher than those in C ($q(4,72) = 23.56$, $p < .01$), or in M ($q(4,72) = 8.94$, $p < .01$).
2. On acquisition, scores in M+RR were significantly higher than those in C ($q(4,72) = 25.96$, $p < .01$), or in M ($q(4,72) = 11.35$, $p < .01$).
3. On acquisition, scores in M were significantly higher than those in C ($q(4,72) = 14.62$, $p < .01$).
4. On generalization, scores in RR were significantly higher than those in C ($q(4,72) = 23.56$, $p < .01$), or in M ($q(4,72) = 12.02$, $p < .01$).
5. On generalization, scores in M+RR were significantly higher than those in C ($q(4,72) = 22.34$, $p < .01$), or in M ($q(4,72) = 17.40$, $p < .01$).
6. On generalization, scores in M were significantly higher than those in C ($q(4,72) = 9.23$, $p < .01$).

Analysis of the Ability to State the Rule

Initially, two x^2 analyses were done, looking at which attributes or attribute combinations were present in S's rule statements. The x^2 comparing the ability of E.C.S. and Grade 1 S's showed no significant differences between the two groups ($x^2(df,3) = 3.03$) at the .05 level of significance.

A second analysis was carried out comparing RR, M, and M+RR S's in their ability to state the rule in terms of the attributes of shape and/or colour (see Table 5). It was found that there was a significant difference, where $x^2(df,6) = 28.67$, $p < .0001$. Significantly more S's in M were only able to state shape as a relevant attribute than for any other condition. There were no significant differences between the ability of S's in RR and M+RR although both were superior to those in M.

A second set of x^2 analyses were done to look at the ability of S's to state the complete rule. Again, results comparing E.C.S. and Grade 1 S's showed no significance ($x^2(df,1) = .07$) at the .05 level.

The analysis comparing S's in RR, M, and M+RR showed a significant difference between the groups, with $x^2(df,2) = 20.96$, $p < .0001$ (see Table 6). Significantly more S's in M+RR and RR were able to state the rule than those in M.

Analysis of Copying Scores

Initially, the copying scores for S's in M and M+RR were compared to determine whether there were any significant differences between the two conditions. A t test was

TABLE 5

x^2 Comparison of the Number of S's in Rule Repetition, Modeling and Modeling plus Rule Repetition on Ability to State the Rule in Terms of Attributes

	Unable to State Rule	States Colour Only	States Shape Only	Able to State Entire Rule
Rule Repetition	1	4	0	15
Modeling	2	3	13	2
Modeling and Rule Repetition	1	2	3	14

n = 60

x^2 (df,6) = 28.67, $p < 0.0001$

TABLE 6

x^2 Comparison of the Number of S's in Rule Repetition, Modeling and Modeling plus Rule Repetition on Ability to State the Rule

	UNABLE TO STATE RULE	ABLE TO STATE ENTIRE RULE
Rule Repetition	5	15
Modeling	18	2
Modeling & Rule Repetition	6	14

n = 60

x^2 (df,2) = 20.96, $p < 0.0001$

done and no significant differences were found ($t = -.97$).

Another t test was done comparing the difference between E.C.S. and Grade 1 S's in terms of the amount of direct copying. Again no significant difference was found ($t = .19$).

The results were then pooled and compared to the probability of getting a copied response by chance. The probability of this happening would be 1 in 36, or 0.0278, since 36 responses were modeled to each S. Another t test was done, which indicated that the number of copied responses was significantly greater than chance ($t = 6.151$, $p < .0001$).

These results are discussed in depth as they relate to the hypotheses in Chapter VI.

CHAPTER VI

DISCUSSION

The major focus of this chapter will be to discuss the results of the study in relation to the hypotheses stated in Chapter IV. Although the hypotheses were presented in terms of the statistical analyses, the results will be discussed with reference to the specific factors, in order to maximize cohesiveness.

Grade

Hypothesés 1, 5 and 7 proposed that there would be no significant difference between the scores of E.C.S. and Grade 1 S's across phases, or in terms of acquisition and generalization separately. In addition, Hypothesis 9 indicated that there would be no significant differences between the two groups in their ability to state the rule. The findings supported these hypotheses.

While other researchers (i.e. Majeres & Fox, 1984; Rosenthal, Moore, Dorfman & Nelson, 1971; Rabinowitz, 1981) have suggested that a change in conceptual development takes place between the ages of 5 and 6 years, Bruner's (1966a; 1966b) theory would not. Instead, he proposes a discontinuous process of development, where it may not be increments in age and verbal experience which are crucial, but rather being in the transitional stage. That these hypotheses were confirmed, lends support to Bruner's theory in which both groups would be in the transitional phase between ikonic and symbolic representation and therefore at a similar disadvantage since neither would be able to use verbal mediators spontaneously.

Methods of Instruction

Hypotheses 2 and 6 which predicted that there would be a main effect for methods of instruction, where scores on M+RR and RR would be higher than those on M, which would exceed those on C, both across phases and for acquisition alone, was confirmed. These findings support Bruner's (1966a; 1966b) theory which would place primary importance on the provision of verbal mediators. Modeling alone would require S's to supply their own mediators, which they would not yet be able to do consistently or very efficiently, given that they are still in the transitional stage between ikonic and symbolic representation.

In terms of generalization, Hypothesis 8 stated that there would be a main effect for methods of instruction, where scores on M+RR and RR would be significantly higher than those on M and C, which would not differ significantly. This was confirmed only in part. Results on generalization were consistent with those on acquisition and across phases. That M+RR and RR were superior to the other two conditions is added support for Bruner's theory which would predict greater generalization when the verbal mediators are provided. The surprising finding was that S's in M did exceed those in C, which was not expected.

This also disconfirms Hypothesis 4 which proposed an interaction effect for phases of concept attainment x condition, where only those S's in M+RR and RR would be able to generalize. This is in contrast to MacFadyen's (1985) findings which showed no generalization for Grade 1 S's in a silent modeling condition. This difference could be accounted for by the degree of difficulty found in the two concept types. Although both studies used a two dimensional concept, MacFadyen's was based on colour and object identity with differing backgrounds, while in this research, only coloured geometric shapes were used. Perhaps, because the coloured shapes provided the S's with a somewhat easier concept type, the children were able to generalize, albeit to a small degree.

Hypothesis 10, which stated S's in M+RR and RR would be more able to state the rule, but would not differ significantly was confirmed. It would appear then, that the addition of the rule statement to the instructional technique is crucial for the induction of the rule for children of this age. This finding also lends support to Bruner's theory which suggests that children in the transitional stage between ikonic and symbolic representation are not consistently able to verbally mediate without assistance.

Phases

Hypothesis 3 stated that scores on acquisition would be significantly higher than those on generalization, which in turn would be higher than those on baseline. This was confirmed and is supported by other studies using a similar design (e.g., Alford & Rosenthal, 1973; MacFadyen, 1985). It was expected that acquisition scores would be higher than generalization scores, because S's did not have to induce and remember the rule until the generalization phase, where they would be at a disadvantage as they would not be receiving any cues, particularly for those children in the modeling condition.

Direct Copying

Hypothesis 11, which predicted that S's in M and M+RR would give direct copied responses significantly more often than would be expected by chance, was confirmed. It could be argued that the scores on acquisition would therefore be artificially inflated as a result. Although this may be the case, it can be said that learning did take place, when scores on generalization are taken into account since these scores would not be affected by copying at all.

Theoretical Implications

This study demonstrates the usefulness of the modeling paradigm for investigating the role of verbal representation. Silent modeling forces the child to make use of his or her own representational system. Varying the types of verbal mediators, such as labels, instructions, explanations or rules, allows for inferences to be made regarding which instructional techniques are most effective in assisting with the mediation and representation of a concept attainment task.

The results from this study can be interpreted as support for several theoretical positions. First, the findings are compatible with a developmental, discontinuous interpretation of the mediation and attainment of concepts, where both E.C.S. and Grade 1 children are in the transitional stage of representation and therefore experience difficulty in spontaneously inducing and verbally mediating a two-dimensional concept. When the appropriate verbal mediator is provided, however, they are able to use it. These findings are consistent with the developmental position in general, and Bruner's (1964; 1966a; 1966b) theory of development in particular.

Secondly, the present findings lend support to Flavell's (1970) production deficiency hypothesis, where although the children were unable to supply their own verbal mediators, they were able to utilize them effectively when they were supplied to them in the rule provision conditions.

Alternately, these results can be taken as preliminary support for Whitehurst & Vasta's (1975) Comprehension-Imitation-Production hypothesis as it relates to concept attainment. The provision of the verbal rule may aid in the child's comprehension of the concept attainment task and may function as a prerequisite for a high level of concept attainment and generalization, as well as the ability to state the rule.

While the data does lend support to both Flavell's and Whitehurst & Vasta's theories, support is strongest for that of Bruner as it allows for specific predictions to be made for the age span of 5 to 7 years, and is consequently more explanatory.

Summary

In summary, many significant results were reported, most of which are consistent with those found in the developmental literature. First, grade was not found to be a main effect which was expected from Bruner's theory which predicts that both of these groups would be in the transition stage between ikonic and symbolic representation.

Further, in accordance with Bruner's theory was the finding that rule provision was of critical importance in terms of the most effective method of instruction. That children of this age require verbal mediators to be supplied to them is consistent with his theory of representation which suggests that although they are unable to supply their own, they can induce a concept when mediators are provided. The finding that children in M were able to generalize to a small degree was not expected, although it may have been a function of the degree of difficulty of the task.

Thirdly, concept attainment scores were higher than those on generalization, which exceeded those on baseline. It is reasonable to expect that when the instructions are removed, performance would drop somewhat. Because generalization scores were higher than those at baseline, it is evident that some learning did take place and transferred to the novel stimuli.

Finally, although some direct copying occurred in the two modeling conditions, scores on generalization indicated that learning did happen as a result. The results were primarily taken as support for Bruner's theory of representation, but could also lend support to Flavell's production deficiency hypothesis or a CIP formulation of concept attainment. Contrary to Bandura's (1977) theory, the data does not support the hypothesis that imaginal representation is sufficient for children to induce concepts from a modeling paradigm.

CHAPTER VII

CONCLUSIONS

The purpose of this chapter is to discuss the conclusions that can be reached as a result of this research, the limitations of the study and the implications of the research as a whole.

The findings of this study support the following conclusions:

1. In accordance with Bruner's (1964; 1966a; 1966b) theory, the results support the hypothesis that children between the ages of 5 and 7 years are in a transitional phase between ikonic and symbolic representation. Performance both in terms of acquisition and generalization, was seriously hampered for the children in the silent modeling condition, which indicates that as Bruner predicted, transitional children have difficulty spontaneously inducing a conceptual rule without the addition of verbal mediators. That they were able to attain and generalize the concept with the provision of the rule, supports the idea that although they have difficulty supplying their own verbal mediators, they are able to use those which are supplied to them, efficiently.
2. Contrary to the findings of Zimmerman and Rosenthal

(1972a; 1972b), which indicated that for Grade 3 and 5 S's, the addition of a modeling component to the rule repetition condition facilitated performance, the present study found no added benefit from the combined condition over rule repetition alone. Because the children in the Zimmerman and Rosenthal studies were older than those in the present research, it could be hypothesized that the younger children require the verbal mediators to induce concepts, whereas the older children are not dependent upon them and are therefore able to access information from both modes of presentation, simultaneously. If this is the case, and older children are able to benefit from a combined instructional paradigm, this holds some interesting implications for future research. The present results do however, support Bruner's hypothesis that supplying the verbal mediators is the critical element for children of this age.

3. Bandura's (1977) hypothesis that only imaginal representation is required to learn from a modeling paradigm is not supported for concept attainment. It was evident that unless the children in this study were provided with verbal mediators, they had difficulty generalizing the concept. Verbal representation does seem to be a requirement in order to

induce the conceptual rule, as Bruner hypothesizes.

4. While direct copying did take place in both of the modeling conditions, it did not interfere with the attainment of the concept, as is evidenced by the high degree of generalization, particularly in the modeling plus rule repetition condition.

Limitations

This study had several limitations. First, the age range used in this experiment was too narrow to show any differences between the two groups. Related to this, is the lack of a comparison group which falls outside the transitional stage. It would have been more enlightening perhaps to have used a group of children who were using either ikonic <u>or</u> symbolic representation, particularly to examine the efficacy of the combined modeling-rule provision group, although a comparison can be made with MacFadyen's (1985) study.

Second, it could be pointed out that even in the silent modeling condition, the word "shape" was used, which could have acted as a cue for the children. Because they did not seem to show any preference for either shape or colour when they stated the rule, it is unlikely that this caused any contamination. It would have probably been better, had the shapes been made out of wood, for example and then they could have been referred to as "blocks" instead.

A third concern is that perhaps 18 trials were too many for children at this age to maintain attention to task, particularly for the children in the modeling and control groups where they received very little interaction from the experimenter.

Finally, it appears to be unnecessary to have a baseline as well as a control group since the baseline acts as a control. The control group was required to go through 54 trials where they received no instruction or feedback for their performance. This was very boring for the children and provided no real extra information for the study.

Practical Implications

Because the study evaluated various instructional techniques as they relate to concept attainment, the results lead to a number of practical implications.

Modeling or visual demonstration was not found to be a successful technique for teaching concepts to children aged 5-0 to 6-11 years. Instead, it was found that children in this age group required verbal mediators in the form of rules to attain and generalize concepts. It is in fact critical to supply these children with the appropriate verbal components to enable them to understand and consequently induce concepts.

It is also evident that a visual demonstration in addition to supplying the verbal mediators does not facilitate or improve performance over what can be expected from supplying only the mediators, for children at this age, for a concept attainment task, where a general rule is being taught.

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