THE UNIVERSITY OF CALGARY

THE EFFECTIVENESS OF THE ORIGINS OF ANALOGY UPON STUDENT LEARNING OF VISUAL IMAGES BY STUDENTS EXHIBITING DIFFERENT COGNITIVE STYLES,

by

JANICE K. IRVINE

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE

DEGREE OF MASTER OF ARTS

DEPARTMENT OF CURRICULUM AND INSTRUCTION

CALGARY, ALBERTA

AUGUST, 1986

ISBN 0-315-32751-0

THE UNIVERSITY OF CALGARY

FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitiled, "The Effectiveness of the Origins of Analogy upon Student Learning of Visual Images by Students Exhibiting Different Cognitive Styles."

Supervisor, Dr. W. B. Clark,
Department of Curriculum and Instruction

Dr. H. Diemert,
Department of Art

Dr. R. J. B. Carswell,
Department of Curriculum and Insrtuction

DATE August 29, 1986.

ABSTRACT

The purpose of this study was to discover if students use analogies in order to learn visual images, and if so, whether the origins of those analogies have any effect on how well those images are recalled as having been seen before.

The sample consisted of 58 Grade Six students from two complete classes in a Calgary elementary school. Subjects were then randomly assigned to one of two treatment groups or a control group. All subjects were first tested for the cognitive styles of Field Dependence/Independence using the Children's Embedded Figures Test (CEFT) and Flexible/Constricted Control, using the Stroop Color Test. A lesson was developed where students viewed a series of black Rorschach type ink blots that were in slide format. In the Teacher Generated Analogy group subjects were asked to remember the ink blot shapes using teacher generated analogies. Subjects in the Student Generated Analogy group were instructed on generating their own analogies, and subjects in the Control group were asked to remember the visual images in any way that they wished.

The results indicated that, though students use analogies when the visual images are presented, they do not necessarily use them for recall purposes.

A relationship was also discovered between susceptability to cognitive interference and recall of visual images, and between the amount of time spent studying the stimulus material and how well the images were remembered.

ACKNOWLEDGEMENTS

Thank you to my advisor, Dr. Clark for his on-going advice, unfailing support and encouragement.

Also, a very special thank you to Cathy and Allan, who were always willing to do what ever was necessary for me to take each step in this journey, and to Kal, who encouraged me and gave me the impetus to complete it.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

OVERVIEW

A recurring concern among designers of educational materials lies in the area of Learning Strategies. Designers aim for maximum learning to occur from their instructional materials, and they are constantly searching for effective designs. The exploratory study reported here was designed to test the efficiency of one learning strategy - association learning through analogy generation using visual imagery. Its purpose of this exploratory study was to test the effectiveness of analogy generation as an instructional strategy under different conditions.

Students are often required to learn lists of names and dates, countries and capitals; name rivers and recognise other geographical data, and to be able to recognise and name shapes of many kinds. One way in which to remember shapes is to form an analogy between the given shape and something with which a student is familiar. The exploratory study reported here investigated whether or not without prompting by a teacher, students actually tended to generate

analogies on their own. It further compared the effectiveness of analogies generated by students when instructed to do so and analogies which were generated by the teacher and subsequently told to the students. Finally, it tested for a potential interaction between two cognitive styles and the effectiveness of the source of analogy generation.

One reason for being interested in strategies such as analogy learning is to facilitate the learning of different types of material by any child in the regular elementary school program.

Approaches to Accommodating Learner Characteristics

There are two general approaches for accommodating learner characteristics - (1) Aptitude Treatment Interaction, and (2) the teaching of learning strategies.

The Aptitude Treatment Interaction (ATI) approach to instruction, recommended by educational researchers such as Cronbach and Snow (1977) advocated adapting instruction to learner characteristics. Approaches to ATI in education such as Individually Guided Education (IGE) which was introduced in Calgary elementary schools in the late 1970's is an example of this technique. This approach proved effective, but also

prohibitively expensive in terms of testing, time for teacher training while regular instruction was being carried on, and in having sufficient instructional resources available for large numbers of students (D.Mirtle, personal communication, November, 1986). Adapting instruction extensively not only increases cost on delivery by requiring extra personnel to work with individual students, but also costs in terms of the expensive development of materials.

Individualization in the elementary classroom usually extends to the modification of instructional materials in a variety of ways. Instruction is manipulated when presented through media such as books, tape recordings, slides, filmstrips and movies, and more recently, microcomputers. (Kanata Kits, 1980, Expressways Reading, 1981,) So far, though, instruction has usually been modified to take into account the amount of information and instruction that the student is capable of receiving, thereby placing the emphasis on content. Should the emphasis shift to the processes that learners employ in order to use instruction efficiently, then the focus will be on learning tasks, learning strategies and mental skills.

The second approach, the Learning Strategy Approach, teaches students strategies that are believed

to be effective in tasks such as remembering material. Strategies can be applied in all grades across subject matter on the initiative of the student. Weinstein (1978) notes that teachers often give students material with instructions to "Learn it", but seldom tell students how to go about the actual process of remembering the material. Learning strategies are seldom systematically taught. Consequently, students often do not learn as much as they might; a general community complaint that is in turn reflected in such things as reinstatement of province wide examinations and concerns expressed by the business community (Harrison, 1984). Those advocating teaching students effective learning strategies claim that it makes students more effective learners.

If the way in which learners process information is identified, the most effective strategies for processing this information are also identified, and individual learners are taught how to use these strategies, then there should be less need for the instructional materials to be modified. If the learners' cognitive style is also identified, effective strategies for learning to take place spite of that style might also be taught. Learning would then become more of the responsibility of the learner, and the

mental skills and strategies used could be transferred to any number of new situations.

Gagne and Briggs (1979), listed five kinds of capabilities that can be established in the learner when learning occurs through instruction. These are

1. cognitive strategies
2. intellectual skills
3. information storage and retrieval capabilities
4. motor skills
5. attitudes that influence personal actions and choices.

Cognitve strategies, intellectual skills, information storage and retrieval capabilities are used for problem solving, concept aquisition and discrimination learning.

The task used in the present study involved generating analogies, which is an example of association learning between a given shape and something in the learner's memory. This task would be classified as a concrete concept by Gagne and Briggs (1979). The shape would have been learned when the

individual identified the characteristic that both the shape and the analogy have in common. This was overtly demonstrated when the student correctly recognised a shape by giving the student analogy that the shape suggested, indicating that the common characteristics between the two had been noted. In contrast to this situation in which students generated their own analogies, analogies might be provided by the teacher. If the teacher generated analogy is successfully remembered, the type of capability used could be information storage, which does not require the same depth of processing as that needed in the cognitve strategy area. Depth of processing will be addressed later in this chapter.

Elaboration Techniques

Developing the skills listed by Gagne and Briggs (1979) requires specific techniques, and it is possible to use elaboration skills as one of these techniques. Elaboration is a cognitive strategy in which links must be made between the incoming material and that which is previously stored. These links can be made interesting, unusual and/or novel through the use of analogies, humour or imagery. (Dansereau, 1978). Elaboration also implies that the learner use a symbolic construction to make information more meaningful and more easily

accessible. (Rowher, 1970.) Elaboration skills can be used as learning strategies. When students are given two lists of words, objects, or pictures, elaboration occurs where these items are placed in an ..."episode, process, or relation involving both of them" (Rowher, 1973). The learner forms links between two items by forming interactive images of them, or by generating a sentence using both words. Mnemonics, or memory facilitation techniques, are a form of elaboration strategy. They have been shown to facilitate learning in many areas by improving the efficiency of one's memory. (Weinstein, 1978). Presented materials can be encoded, recoded or transformed through the use of mnemonics. The content can be reduced (as in stimulus selection) or elaborated (as, for example, in using visual imagery to remember noun pairs or important dates).

The development and use of mnemonic systems can be traced to ancient Greek times. Simonides (ca. 500 B.C.), a Greek poet, is one of the first known users of mnemonics. Shortly after leaving a banquet, the hall that he had been in collapsed. He was able to recall where individuals had been seated and so could assist in the location and identification of the dead.

Today, many children first learn the alphabet using a metrical mnemonic. Relations or patterns are learned using a rhyme, and this case, a tune. To miss a letter or a step would destroy the song. Other mnemonic systems use peg words, mental imagery, and different codes, (Paivio, 1971). A mnemonic such as Every Good Boy Deserves Fruit would give the placement of notes on the lines of the music treble cleff by providing the names of the notes as the first letter of each word of the rhyme. In the learning of the order of the presidents of the United States, using loci and peg words, as described by Levin et al.(1983), imagery plays a central role in the skills described. Students are required to generate images to go with the words and places to be learned that correspond with the numerical order of the material to be learned.

Use of elaboration strategies such as mnemonics is not confined to any particular age group of students. Very young children, as young as four years, have been shown to be able to generate elaborative imagery, though the ability to use imagery techniques develops with age. By eleven years of age, children appear to be no more constrained in their use of imagery mnemonics than are adults. (Pressley, 1982.) Rowher (1973) holds the position that the older children become "the less explicit the prompt necessary to activate elaboration."

(p.8). Younger children would require detailed instructions in elaboration skills, but older children should be able to use their elaboration skill over a wide variety of settings and with a wide variety of materials. This is in itself an argument for instructing students in the use of elaboration strategies as young as possible and giving them ample opportunity in which to use them.

Wood (1967) gives three reasons for using a mnemonic system approach when wishing to aid memory. These are:

1. more concrete, and possibly abstract words are recalled when using a pegword list;

2. lists are more likely to be learned in order when a peg list is used,

3. materials in the middle of a list are more likely to be remembered.

The classic mnemonics system implies that there is a symbolic transformation from word to images and back to words, (Paivio, 1971). In the present study, where analogy learning is assisted by an imagery mnemonic, the presented shape is transformed to a visual image, then back to the shape. The symbolic transformation is

from image to image to image, with the verbally presented association providing the link.

Depth of Processing

This exploratory study was also concerned with depth of processing. Students using teacher generated analogies would not have to process the information in the same way as students who must generate their own analogies. If the teacher gave the analogy example that the shape looked like the cross section of a tamarillo, the student must already have a schema for tamarillos.

If not, then the analogy would fail, and the student would fail to remember the shape by using the analogy. Should students be required to form their own analogy though, they would draw on something already present, and so would have something with which to associate the shape when it was presented on subsequent occasions. The condition of comprehensibility depends on the goodness of fit between the teacher or author and the student. The author (or teacher, in this instance,) must make presumptions about what the reader or student already knows. (Adams, Bruce 1980). If the student is required to make the association, which in the case of this study is an analogy, then this does not become a factor, because the student can only make an association with what is already known. The student

who is required to generate an analogy is processing information at a deeper or more extensive level than the student who is presented with a teacher generated analogy. The source of information, and the connections, which are known as schemata, must be activated in order for the analogy to be created.

Schema Theory

Rumelhart (1979) stated the following:

> Schemata truly are the building blocks of cognition. They are the fundamental elements upon which all information processing depends. Schemata are employed in the process of interpreting sensory data (both linguistic and nonlinguistic), in retrieving information from memory, in organising actions, in determining goals and subgoals, in allocating resources, and, generally, in guiding the flow of processing in the system (p.34)

Knowledge, according to schema theory, is packaged in the mind into units (Rumelhart, 1979), to be retrieved under certain circumstances. Schema theory will be addressed in more detail in Chapter 11. Briefly, however, learning takes place when new information is assimilated into exsisting schema. This

sort of learning would take all the "fact learning" or the majority of learning into account. Rumelhart and Norman (1977) have called this "accretion". When the existing schema must be changed in order to take in the new information, then accommodation occurs, referred to by Rumelhart and Norman, (1978) as "tuning". This takes into account the building, modifying and refining of existing schemata. The actual creation of new schema is another matter. Rumelhart and Norman (1978) call this process "restructuring", and describe two ways that it occurs. "Patterned generation" is the creation of new schema by analogy. An old schema is copied with modifications. "Schema induction" however, calls for the formation of a schema that consists of the repeat of the certain spatio-temporal configuration of the schema that came before.

Learning through student generated analogies would be accretion learning. The learner would take in new information into existing schemata. Learning by teacher generated analogy, however, may involve "patterned generation," depending on whether or not accretion occurred. Where a new schema is being created, the individual must try to learn the shape through analogy, trying to locate in memory something that would be compatable with the new shape.

In activating schemata for the purposes of learning by assimilation, students would be required to use imagery. The shape that is presented is associated with something in the physical world, and the student must use imagery in order to make the connection between the two.

Imagery

Student use of imagery in the present study was critical. The student was required to view the shape, then use imagery in the subsequent analogy formation. This would be so in both student generated and successful teacher generated conditions.

Imagery has been a controversial subject over the past century. Watson, (1913), rejected the whole notion that mental events and images were fit for study by psychologists, and therefore would not accept imagery as a valid construct. Imagery today is accepted in the field of Educational Research, (Gomulicki, (1953), Yates, (1966), Robins and Shepard, (1977), Shepard, (1978), Levin et al, (1983), Pressley, (1983)).

Visual imagery, for the purposes of this study, is an internal cognitive process whereby an external object is transformed to an internal representation of reality. Kosslyn, (1980), tells of the "mind's eye" as

an interface with a conceptual system that looks at the display and classifies it in terms of semantic categories. He goes on to use the metaphor of the Cathode-ray tube to describe how imagery can be explained. Images are transmitted to the display from surface images (in short term memory,) which correspond with various portions of the imagined object such as color or distances between points, and also from information stored in long term memory that can be converted to a surface image. Images depict information rather than describe it. The representations are not necessarily photographically accurate, because they are dynamic entities; constantly changing; have parts that fade in and out and require an effort to maintain. The underlying deep structures may not be pictoral at all, but may be transformed into pictoral form when the image is generated.

Cognitive Style

It has long been known that individuals acquire and process information in distinctly different ways.

This would include everything that an individual sees, remembers and thinks about. It does not refer to the amount of information that is perceived or to the ability of the individual. Rather, it refers to the manner and form in which the individual receives and

stores information. These individual differences have come to be known as cognitive styles. Slow to develop, they are consistent and stable, and are quite resistant to change. They are different from abilities, and the methods used for testing for them are different from those that measure the quantity and quality of knowledge. The tests measure HOW rather than WHAT.There are eleven dimensions of cognitive style as described by Ausburn and Ausburn (1978), but only two dimensions (Field dependence/independence and susceptability to cognitive interference, or Flexible/ constricted control) were addressed by this study.

These two dimensions were selected for several reasons. By far the most extensively studied has been the style of Field Dependence/Independence, so there is a considerable body of knowledge upon which to draw. Both this style and that of Flexible/Constricted Control have been found to be related to learning in an educational setting such as the elementary school.(Ausburn and Ausburn, 1978.) Conveniently, tests for both were available and suitable for the subjects chosen for the study. Both cognitive styles and the tests will be further discussed in Chapter 11.

Though studies were located that discussed the interaction of Cognitive Style on many areas, such as

the effect of Cognitive Style on reading achievement, (Rasinski,1983), no studies were found that examined the effect of cognitive style on learning strategies. This would lead to the hypothesis that learning strategies such as association learning would not be affected by cognitive style.

The Population

Children at the upper elementary school level are often required to perform the type of tasks described earlier - that is, to learn lists and to identify shapes. They would benefit from learning association strategies. At about eleven years old the tests are relatively easy to administer and the children are eager and interested in participating in them. As the children in the present study were in their sixth year or more of formal education, it was expected that they would have few difficulties in following the directions and would enjoy the extra attention given during the individually administered trials and tests.

One would conclude that learning strategies could be successfully used in elementary classrooms. Should the approach become fully acceptable, the far reaching implications would be that fewer resources such as time, money and effort would be needed to produce

instructional materials in the traditional manner. Instead, one form of instruction could be presented to all learners. Task analysis would reveal to the instructional designer what learning processes would be needed in order to master those particular skills. The learner would be told what learning strategies to use -- for example, whether analogies should be used, or serial processing, or associations should be made. The learner would be responsible for individualizing the material in that he would know what learning strategies were successful for him, and would have been instructed in their use.

In order for this to be "true" certain conditions must apply, that is, the strategy is effective across all students, and does not interact with such learner characteristics as cognitive style. Of supplementary interest is the comparative effectiveness between circumstances in which students are told analgoies compared with those in which students generate their own.

Specifically, this study tested the following hypotheses:

H1. Analogy learning through the generation of analogies is an effective learning strategy for all students to remember visual images with.

H2. There is no interaction between cognitive style and the source of analogy on the effectiveness of analogy learning through the generation of analogies.

H3. Students will use analogy learning strategies after being instructed to do so.

H4. Students generating their own analogies remember more shapes than those students who are told analogies by the teacher.

CHAPTER II

LITERATURE REVIEW

This chapter will focus on research in the areas of the cognitive styles of field dependence/ independence and constricted/flexible control; schema theory; imagery; and elaboration techniques as learning strategies as they relate to children in a school setting.

Learning Strategies

Before learning strategies can be described, the relationship between learning and instruction must be made clear. Learning is influenced by factors in the living environment of the individual. They include events the individual lives through - those that children experience in their homes, schools, social contacts and geographical environments. Gagne (1965) separated learning from growth and stated that it does not happen naturally, but happens under certain conditions which can be altered and controlled. He goes on to say that ..."learning is a change in human disposition or capability, which can be retained, and which is not simply ascribable to the process of growth." (p.5) Learning then, according to Gagne and

Shuell and Lee (1976) can be seen as a process that has been made possible only by exposure to a particular treatment. The change that is seen in the individual must continue over time, and while this change is not necessarily observable as a change in a performance capability, it does involve a change in a person's knowledge or a change in an attitude, interest or value.

Many researchers used to view learning primarily as a link between a stimulus and a response. Such learning would have two characteristics:

1. it would concern a single connection between a stimulus and a response,

2. the stimulus and response would become integrally bound together. Gagne labelled this Type 2 learning and believed that it was a gradual process of discrimination from incorrect to correct stimuli.

In the last decade, however, emphasis has shifted somewhat from the behaviorist view mentioned above to a cognitivist point of view. Many psychologists have more of a concern for cognition and information processing (Shuell 1980). Wittrock, (1978) in discussing what constitutes this focus emphasized the ..."active,

responsible, and accountable" role that the learner holds in generative learning. Others, such as Norman, Gentner, and Stevens (1976), include in this understanding of learning the modification and assimilation of schemata. (Schemata will be discussed in greater depth later in this chapter.) Shuell suggested that instruction involved the control of learning processes. This means that instruction operates externally to the learner, while learning concerns internal processes. These internal processes include those psychological processes by which a learner perceives, assimilates, interprets, stores and retrieves information. Creating a mental image, such as the layout of a familiar place, and the manipulation of this image, such as travelling down a particular hallway, would be an example of such a process. A learner may not always use these processes though, or may be adept at using only some of them. Those processes that are used productively in learning are known as "mental skills". As Winn (1982) stated, when these mental skills are used successfully in learning, either by free will or on instructions to do so, the skills are said to be "learning strategies." When, for example, visual imagery is used by a learner in order to learn something, then it is said to be operating as a learning strategy. When strategies control the

learning processes, mental skills are developed by learners. It is a three step process.

1. Use of basic cognitive processes that are common to all regular learners found in the regular school program of studies. Forming analogies would be an example of this.

2. Using mental skills, which can be controlled either by the learner or the instructional materials. For some learners to form and manipulate analogies is to use them as a mental skill.

3. Learning strategies. For example, when a learner uses analogies to learn the definitions of certain new words, the analogies would then be operating as a learning strategy.

The use of instructional strategies in instruction by instructional designers can develop mental skills, and training can cause learners to use learning strategies.

Dansereau (1978) identifies and labels two classes of instructional strategies:

1. primary strategies,

2. support strategies.

Primary strategies are those which operate directly on materials. For example, a student required to use a projector must be able to decode the authors' words and pictures in the operating manual into meaningful propositions and images, and must be able to act on this information. Primary strategy areas would include identification, comprehension, retention, retrieval and utilization. Support strategies would consist of those strategies that allow the primary strategies to flow effectively and efficiently. Among them would be techniques for creating and maintaining an appropriate learning attitude and techniques for correcting a situation where this attitude is being threatened by influences such as distractions from within or from outside of the learner.

The present study examined the effectiveness of a particular learning strategy; that of association learning using visual imagery. This is a strategy that involves identification, comprehension and retention,

and would be classified by Dansereau as a primary strategy.

Rigney (1978) distinguishes between detached and embedded strategies. Although, as he states, cognitive strategies are always performed by the student, the actual strategy and the processing that is required by the student may not always be obvious to them. A detached cognitive strategy is one that is independent of the subject matter. A student generated association would be an example of this. The student is given explicit instructions to perform a particular cognitive strategy, in the present case, to make an association. In contrast, when using embedded cognitive strategies the student is not as aware, if at all, of the strategy that is to be employed. Instead, the instruction is so designed as to make sure that the student uses a particular strategy. An example of this would be posing questions that force students to use long-term memory.

From the behaviorist view, in a school environment, instruction has a well defined task. It must design in some way a set of conditions so that a certain performance can be attained, based on some theory of learning. As Glaser (1980) describes, there are many such theories, from those that are developed by psychological scientists to those that are gradually

built up intuitively over many years by experienced teachers. Just as opinion has developed from the stimulus-response to the cognitive outlook in regard to learning, so researchers take a similar cognitive view to instruction.

Resnick (1983) gives a very broad definition of instruction when she says that it is ..."anything that is done in order to help someone else acquire a new capability." (p.5). To determine what that "anything" would be, a list would need to be compiled, and would likely include content objectives, task analysis, learner analysis, behavioral objectives and evaluation. Instruction, then, does not necessarily need to be "school type tasks", but can include anything that occurs so that an individual learns something more easily. This could include the step-by-step instructions that enable an individual to operate a self-serve gas pump or the symbols that tell a skier of the type of terrain that is available.

Instruction, then, is an external event that influences the internal event of learning. It concerns control of the instructional events such as those designed by the instructional designer, the teacher, or the text book writer.

The use of mnemonic strategies in instruction has been shown to be an effective device to enhance retention. Wood (1967) in a series of five experiments demonstrated that when subjects were instructed to make associations between peg words and words to be learned, recall of the response words was markedly facilitated. Groninger (1971) instructed subjects in using a form of loci mnenonic as an imagery technique by which to remember a list of words in a given order. The results, taken after one and five weeks, showed that learning was faster and there were fewer errors in the order of recall in the imagery condition. Levin et al. (1983) successfully instructed eighth graders in the use of a complex pictorial mnemonic strategy to learn the numerical order of the first 14 American Presidents. As in the present study, the above studies used imagery and analogies as learning strategies. Both of the afore mentioned were successful learning strategies, which would suggest that to use these strategies for remembering visual images such as ink blot shapes would also enhance memory.

Mnemonic Strategies

Mnemonic strategies, generally, involve embellishing or elaborating the material to be learned. As earlier described in Chapter One, Simonides recalled

the seating arrangements at a banquet and so could identify the places where guests were sitting when the roof collapsed. This system used the visual imagery of the people involved and the orderly arrangement of the familiar location.

There are many examples of mnemonic techniques.

One example would be when remembering the names of the lines of the treble cleff in music the student would recall the phrase, "Every good boy deserves fruit." The first letter of each word is also the name of the letter of each line of the treble clef. Another example would be, "A Red Indian thought he might eat turnips in church." The first letter of each word when put together would correctly spell the word "arithmetic".

Peg-word mnemonics have often been used to learn lists of various kinds. A rhymed peg word list would be learned first, for example, one - bun, two - shoe, three - tree. Levin et al (1983) used familiar concrete words as peg words in the complex mnemonic system used to teach order of the presidents of the United States. Following memorization of the peg list an image is formed containing the new word to be learned and the old one interacting in some way. For example, if the third name in a list to be learned was "Trudeau," the

image of, for example, a bowl of bread dough in the branches of a tree could act as the mnenonic. The visual image of the pegword "tree" would remind the learner of the word "three", and the visual image of the dough would be a rhyming reminder of the word "Trudeau".

A further example would be the loci method. The learner first picks a very familiar route, and places the items to be learned in various locations. To retrieve the items, the learner mentally travels back along the route, picking up the items at the designated points. Loci can also be a season, such as winter or summer, or a symbol of a festival, such as a Christmas tree.

The present study did not use the above techniques, but instructed learners in the use of their own ability to form analogies using visual imagery as an elaboration or mnemonic technique.

Visual Imagery

Researchers, historians and psychologists have had conflicting views of visual imagery through the ages. Plato (see Gomulicki, 1953) believed that perceptions and thoughts were impressed upon the human mind as if they were on a block of wax. They would be remembered

and thought of and known only as long as the image would last. Simonides (ca. 500 B.C.) thought of an image as an associative mediator. Galton (1883) defined a visual image as ..."the most perfect form of mental representation where the shape, position and relations of objects in space are concerned." (p.113.) These views were rejected by behaviorists such as Watson (1913). He, and others of his day thought that the concept of imagery was unacceptably mentalistic, and as empirical support for imagery was lacking, they rejected the view that it would have any functional significance in behavior. Many early investigators, as Paivio (1971) pointed out, thought that implicit verbal responses were the mechanism responsible for functions that had been previously attributed to images in association, memory and thought.

More recent researchers, such as Shepard (1978) have quite a different view. He said that

> the notion that the internal process that represents the transformation of an external object, just as much as the internal process that represents the object itself, is in the large part the same whether the transformation, or the object, is merely imagined or actually perceived. (p.135)

Kosslyn (1980) believes that imagery must go along with "ideas". Even the most elementary of ideas must be represented by something, and that something does not have to be represented by words. He uses the metaphor of the cathode ray tube to describe visual mental images. He also makes a distinction between pictorial surface images and deep underlying representations. These deep representations consist of information in long term memory, and they can be converted to surface images. They also need to be activated to be maintained. In the present study subjects were required to view shapes and to associate them with something from the real world of the individual. Those subjects being instructed to form their own analogies as well as those subjects being given analogies were therefore expected to be drawing on information held in this long term store. The difference between the conditions would be that those forming their own analogies, would by that very act be drawing on their personal long term memory store. Subjects being instructed to use an analogy given by another individual may not be able to make the association because the necessary item may not be represented in the individuals memory.

The use of visual imagery for problem solving has long been recognised. Watson (1968) and Crick, in their work with the DNA molecule actually built models of

structures to support their visual imagery. In using visual imagery an individual can imagine, manipulate and transform objects in time and space, without making it a physical reality.

The links between visual imagery and pictures are quite clear. Both are representations of reality. Knowlton (1966) describes a picture as an "iconic" sign. Unlike a digital sign such as a word, it represents that for which it stands. While a picture is not totally arbitrary, in order for it to be understood, it does involve a good deal of conventionalization. A visual image is not bound by this, as it need only be understood by the individual concerned.

Recognition memory for pictures has been shown to be high. Shepard (1967) tested subjects after presenting them with 748 colored pictures. In testing whether the stimulus was recognised, a "forced choice" technique was used. Two pictures were projected side by side and the subject had to make a choice as to which was the "old" or "new". This was done to avoid difficulties of possible response biases that were thought to occur where test stimuli were presented singly.The subjects recognised an "old" stimulus in 98% of the test pairs. Should there be no response bias,

Luce (1963) showed that the probability of a correct response is exactly the same in a forced-choice as in a yes-no procedure. This finding influenced the decision to use a yes-no procedure in the case of the present analogy source study that also used visual imagery.

Standing, Conezio and Haber (1970) showed three subjects 2,560 slides of various snapshots over four days. These snapshots included color and black and white pictures. The content of the pictures covered a wide range. Some contained symbolic information such as words, letters or numbers, while others used human, mechanical, vegetation, mineral, or animal subjects. Recognition of the stimuli was 95%, 93%, and 85%. In other experiments other subjects' recognition of the same pictures was as high as 96% and as low as 88%. This suggests a large memory for visual images, keeping in mind that these experiments used pictures of humans, animals, vegetation, and other objects, and that the subjects were only required to signal that they recognised the picture. The pictures were not necessarily familiar to the subjects, but many were of everyday objects.

The effectiveness of the source of association investigated in the present study differs from the Standing, Conezio and Haber (1970) study in that the

pictures in the present study were ink blots, and all were novel to the subjects. Furthermore, the subjects were required to visualize objects within the new shape. Never the less, the afore mentioned studies would suggest that should a shape appear familiar in some way, be it a place, face, mechanical tool or ink blot, memory for it should be enhanced.

Socioeconomic Status and the use of Learning Strategies

Though socioeconomic status (SES) has long been studied as a variable in learning and instruction studies, the effects of it on learning strategies are not clear cut. In the following study where SES was used as a variable, it was found that the use of learning strategies had differential effects on different groups.

Rowher and Ammon (1971) divided 60 high SES and 60 low SES second graders into three treatment conditions. All students were required to learn a list of 25 noun pairs presented aurally and a mixed list of 25 noun pairs presented both aurally and visually. Those students in the training condition were trained in the use of several elaborative learning strategies. They received instructions in the use of self-repetition of presented pairs, verbal labelling of pictorially presented stimuli, and the generation of sentence

elaborators. Students in the practice condition received instruction in self-repetition of the pairs. Students in the control condition participated only in the posttesting sessions. Elaboration training for the two groups was found to be effective, but differentially so. High SES students in the training condition performed significantly better on the aural list than students in the practice or control conditions. Low SES students in the training conditions performed significantly better on the mixed list than students in the practice or control conditions. Training in the use of an elaboration strategy therefore appears effective regardless of SES, though different effects may be observed in different sub-groups.

That there are differences between the language used by children from high SES and low SES has been known both intuitively and empirically by researchers, teachers and others. Hawkins, (1969) Williams and Naremore (1969) and Osser (1971), have conducted studies to show that the differences can be documented. To speculate that one group or another is better, however, cannot be defended in a society that encourages and nutures individuality in its members. As Osser points out, in order to develop communicative

competence, a child must acquire several rule systems, including

1. the formal linguistic rules of his dialect;

2. the sociolinguistic rules of his cultural group;

3. socio-cognitve rules, such as what kind of analysis of the listener's characteristics should be undertaken. (p.182)

Children from both high and low SES groups learn the respective rules of the language that they use, and there appears to be few problems with this until the children enter the school system. There, a standard form of language is most often in use by the teacher and by the materials used, from books to films to programs used with computer assisted learning and to other forms of media. This standard form is usually that used by the high SES group, and this is where students not fluent in this form are sometimes at a disadvantage.

Rather than including SES as a variable, the present study chose to control for SES by using subjects from one general social class only, that of

middle SES. In doing this, the question of potentially different results for subjects from different SES areas of the city was not addressed.

Cognitive styles

Individuals display consistent differences in the way that they perceive, organize, see and remember, and in the ways in which they apprehend, store, transform and utilize information. It must be made clear that while abilities may also involve this, cognitive styles refer more to the manner in which information is processed, rather than the amount or level of the information. The consistent differences remain over time, and are known as cognitive style (Witkin, Goodenough, 1981). Some of the dimensions of cognitive style have been extensively researched and a few have clear educational implications. These are discussed later in this chapter.

Cognitive style does not deal with the amount of knowledge that an individual possesses or is capable of processing, and is not to be confused with intellectual capability, though there appear to be some linkages with IQ. (Kogan, 1976.) Cognitive styles are different from cognitive strategies, which Messick (1976) describes as information processing strategies. Strategies, unlike cognitive style, can be changed

through training, and different strategies can be employed for different types of task. Cognitive style concerns the differences that an individual displays in cognition (Ausburn and Ausburn, 1978). Cognition is the process by which individuals acquire knowledge and includes perception, imagery, thinking and memory.

Ausburn and Ausburn (1978) list 11 different dimensions of Cognitive Style. Two of them, Field dependence/independence and Flexible/Constricted control were used in the present study, and as such are described in detail later in this chapter. One of the others that appears to have some implications for the educational process but which was not used for this study would be the dimension of reflection/impulsivity. This involves childrens' own evaluation of their hypotheses and solutions. Some children take considerable time to reflect upon their decisions in different circumstances. They seem to regard an answer from all angles and are willing to change it before deciding upon a final answer. Other children act upon the first idea that occurs to them, and do not consider the appropriateness of the answer to the question or problem. This style was not included in the present study because the task of association learning using visual images did not readily lend itself to the formation of a hypothesis and a solution.

Another style that has seemed intuitively to have some implications for educational purposes but again, was not studied here, is levelling/sharpening. This dimension concerns reliable individual variations in assimilation in memory. An individual at the extreme levelling side of the dimension is inclined to blur distinctions and merges them with previous experiences. Even when events and objects are remembered the differences between them tend to be lost. At the other extreme, the individual who displays the sharpening dimension magnifies dimensions, and is less likely to confuse similar objects. Again, the task of analogy learning was not considered appropriate to study this cognitive style with.

As has been stated, educators sometimes link these two latter cognitive styles with instruction and learning as they occur within the regular school system. However, there is no readily available evidence at this time for speculation of this kind, though researchers such as Ausburn and Ausburn (1983) continue to work in the area of cognitive style, particularly with field dependence/independence using subjects from emerging developing countries of the third world.

Cognitive style research had its beginnings in the New Look movement in perception. (Witkin, 1950). Some

psychologists in the 1940's were concerned that the approaches to perception of the day did not take the person who did the perceiving into account, and wanted to take a fresh new look at the field, hence the label "New Look." (Witkin, Goodenough, 1981). They thought that the interests, needs, values and personality structure of the individual must be examined in relation to that persons' perception. In doing this, the individuals' instinctual drives would be separated from the perceptual and cognitive functions. They emphasized that no one cognitive style or dimension within a cognitive style is preferable to another. Each has its own strengths and capabilities.

The cognitive styles examined in the present study are field dependence/independence and flexible/ constricted control.

Field dependence/independence

This style has been the most extensively researched of all the styles. As early as 1948 Witkin and associates started publishing studies that dealt with an individual's perception of the upright, which is described here. One of the first tests to be developed was the Body Adjustment Test (BAT). Subjects seated within a small tilted room was required to to adjust their own bodies to the upright position from a

tilted position. Those persons who adjusted their body close to the upright position regardless of the tilt of the room were indicating that they viewed their body as separate from the surrounding field. The body itself was the referent for judging the body. These persons would be known as field independent. At the other end of the scale, those persons who tilted their body towards the axis of the tilted room around them were indicating that their body was not being viewed as separate to the surroundings, and that the external field itself was being used as the referent. These persons were known as field dependent. Researchers found that though individuals were very different in performance they were self consistent in the manner in which they established the upright, as previously described, across different tasks. The Rod-and-Frame Test (RFT), another test to determine field dependency, required the subject to adjust a luminous rod within an adjustable frame. The Rotating-Room Test (RRT) required subjects to bring their bodies on a tilting chair to the position that was perceived as upright within a rotating room. All these tests require the postioning of the body. The Embedded Figures Test (Witkin, 1950) does not require the extensive laboratory equipment that the afore-mentioned tests do. Instead, the subject is required to locate a simple figure that is

incorporated within a complex figure. This test, and a similar one especially designed for children, the Children's Embedded Figures Test (CEFT) by Witkin, Oltman, Raskin, and Karp (1971) are the most widely used today.

The test that was used for the present study was the CEFT. This test has been especially developed for children. It is not timed, and so does not put unnecessary pressure on the subject. The subject is given two different shapes made out of cardboard: a triangle and a house shape. A set of increasingly complex pictures are shown to the subject, who is required to find one or the other of the shapes within the picture, without referring back to the cardboard shape.

Field Dependence/Independence is scored on a continuum. Individuals become progressively more field independent with age and maturity, with little further change after the mid-teen years. Pierce (1980) noted that field independence is related to Grade level. Grade Three students were tested as being significantly more field independent than Kindergarten students. There have been attempts to determine if there is any correlation between field dependence/independence and sex. While it has been found that males tend to be more

field independent than females the difference is small, and usually not significant. (Witkin, Goodenough, 1981). Other studies have have linked field dependence/ independence to child rearing, cultural and training factors, and there have even been proposals that link this cognitive style to genetic factors. (Witkin, Goodenough, 1981).

Wineman (1971) and Rasinski (1983) both note that some students having a style such as field independence are likely to be better readers than field dependent students. Wineman tested 270 subjects from grades 4, 5 and 6. Each grade contained approximately the same number of male and female subjects. The subjects were required to complete a booklet arbitrarily entitled the C-S Drawing Test, which required the subjects to draw any person they wished, to draw a person of the opposite sex and to draw both of their parents. The reading scores as determined from the previous year's testing using the California Reading Test - Elementary (CRT) and the subscores from the California Achievement Test (CAT) determined reading ability. The drawings were scored using a method developed by Witkin, et al (1962). Significant statistical relationships were noted between the figure drawings and the reading scores for both the male and female 4th grade subjects and between the figure drawing and the reading scores

in the female subgroup from the 6th grade. There was no significant relationship between the figure drawing and the CRT scores within either 5th grade subgroup. The study found correlations between cognitive style and reading ability for both males and females. Witkin and Goodenough (1981) point out though, that field dependent students are more likely to have more socially acceptable personality traits than field independent students, and are selectively attentive to social information obtained from other peoples' behavior. Witkin is adamant that no one dimension within the style is preferable or better than the other. The style is value neutral in that each pole has characteristics that are adaptive to particular situations and in certain contexts. As Rasinski (1983) documents, research into this style has extended to the motivation for learning area, and it is now known that field dependents are more reliant on external reinforcements and externally defined goals while field independents respond more to intrinsic type motivation and rewards.

Vocational preferences are different for field dependent and field independent individuals. (Witkin, H.A., Moore, C.A., Goodenough, D.R. and Cox, P.W. 1977.) Field dependents prefer the type of vocational domain where interpersonal and social skills are

required, such as those found in the social worker, elementary school teacher and personnel director fields. Those individuals having a cognitive style of field independence are more likely to choose a vocational field where cognitive skills are emphasized over interpersonal relations, such as in the fields of engineering technology or in the business production area.

As existing research by people such as Stuart (1967) and Wineman (1971) has clearly noted, field dependents tend to be poorer readers. The Wineman study has already been described. Some researchers, such as Allington (1983) and Collins (1982) have noted that the field dependent students tend to get extensive practice in word and sound analysis, and are often required to work alone in solving comprehension problems. Yet for these students, analysis is most difficult. They tend to view the world in a global sense, seeing the whole, rather than the different parts. It could be speculated that these students could benefit from more instruction in passage comprehension, and instruction requiring discussion and dialogue, which is often the type of instruction offerred to the more field independent students.

Most of the tests given in a school setting deal with ability and achievement, (Kogan,1971). The tasks that are usually expected of children and the manner in which instruction is presented to them is often dependent on tests of ability and achievement. The results of these tests sometimes suggest instructional practices - for example, the grouping of students for instruction by high, medium or low I.Q., or offering reading instruction to the good readers in groups that require extensive interaction among the members. Existing research on the educational implications of some cognitve styles, would suggest that for some students, this may not be the most effective method.

Spiro and Tirre (1980) developed a test for college students using Anderson, Spiro and Anderson's (1978) study passages. These passages were narratives about the same items of food purchased in a fancy restaurant and on a trip to a supermarket. The items were presented by the well known categories of appetizer, salad, dessert, etc. for the restaurant condition. The types of food to be bought on a trip to a supermarket were not nearly as confined. The primary result of the experiment was that the subjects in the restaurant condition recalled more of the food items than the subjects in the supermarket condition. It was speculated that individuals utilized the schema that

they already possessed as a type of scaffold in order to remember information from text. In the Spiro and Tirre study, subjects were required to read the supermarket or restaurant passages, were then given the Group Embedded Figures Test (GEFT), and the Wide Range Vocabulary Test,. The latter was given to remove the variability that could have been explained by differences in verbal ability. After these tests, and with no time specifications, the subjects were asked to recall as much as possible from the restaurant or supermarket passages. Food items from the supermarket passage, where it was speculated that the foods were not recalled within the categories of beverages, appetizers, etc. were equally well recalled by both high and low scorers on the GEFT. On the restaurant passage, where it was theorized that the "scaffold" of larger categories could be used, food items recalled radically increased for the higher GEFT scorers. Even those subjects whose GEFT scores were only one half standard deviation from the mean showed considerable improvement on the restaurant passage. It can be inferred from this that individual use of schema utilization can have an effect on memory. Schema theory and the utilization of schemata as they relate to the present study on association learning is discussed later in this chapter.

Flexible/Constricted control

Individuals show differences in their ability to resist cognitive interference. This is known as the cognitve style of Flexible/Constricted control. In a school setting this dimension would be most evident in the ability of an individual to ignore cognitive distraction and concentrate on a selected task.

The test for this dimension is usually the Stroop Test (Stroop, 1935), and it was a version of this test that was used for the present study. This test has been reviewed in detail by Jensen and Rowher (1966). The test was developed by Stroop (1935). He had noted that there was a time difference between color recognition and word recognition. The test contains three stimulus sheets. The first contains the names of colors printed in black ink. The second sheet contains patches of colors, and the third contains the names of colors printed in a different hue from that color. For instance, the word "blue" could be printed in green ink. In one part of this test the subject is required to first name the color patches and then name the hue of the ink that the color names are printed in. The time difference between these has generally become known as the "interference factor" and has been accepted as a measure of constricted/flexible control.

A subject with constricted control is operationally defined as one who scores low on the Stroop test, and who can block out conflicting signals or information. Such an individual can give the name of the color of ink displayed regardless of the actual word. Individuals displaying this dimension of the style can constrict their attention to the particular task at hand. In contrast, the individual displaying the flexible dimension of the style is susceptable to the interference of the name with the color of the ink the word is printed in.

Memory and Depth of Processing

In order to remember the presented shape either through student generated associations or teacher generated associations, students must draw on knowledge that is already present. The form of the association, or the actual image is not as important as the underlying structure that is activated in the memory store of the individual.

Craik and Lockhart (1972) agree with researchers such as Selfridge and Neisser (1960) and Sutherland (1968) that stimuli are rapidly analyzed at a number of levels or stages in order for perception to occur. The introductory stages concern the analysis of such physical or sensory data as pitch and loudness, lines,

angles and brightness. At a later stage occurs the matching of these data with the abstractions that are already stored. The later stages are concerned with recognition of patterns and extraction of meaning. After this recognition the stimuli may undergo further processing. They may be enriched or elaborated, and may trigger associations, images or stories on the basis of the individuals' past experience. The stimuli can be from a wide variety of sources. They can be in the form of a word, a sight, sound or smell. The stimuli proceed through different levels of matching or pattern recognition until it can be matched with material in what Craik and Lockhart (1972) term the "Long Term Store."

They

> prefer to think of memory tied to levels of perceptual processing. Although these levels may be grouped into stages (sensory analysis, pattern recognition, and stimulus elaboration, for example), processing levels may be more usefully envisaged as a continuum from the transient products of sensory analyses to the highly durable products of semantic-associative operations. (p.676).

Stimuli can be kept at one level of processing, and need not proceed to a deeper level. This is what would be generally known as "keeping the items in consciousness", and is what Craik and Lockhart refer to as primary memory (PM). Only a limited quantity of information can be kept at this level, though, and the individual must allow it proceed to deeper levels in order to make greater use of learned rules and past knowledge. Some types of information can apparently be maintained in the PM more easily than others. Phonemic features of words are apparently much easier to maintain than visual features of words.

In the case of the present study, it was speculated that the presented visual image, or the ink blot, would enter the primary store of the individual. From there it would proceed through several levels of processing. When the individual connected the shape the ink blot suggested with knowledge already in store, then the new information would be processed at that level, and the PM made available for new stimuli to enter into it. It was further speculated that the source of the analogy would determine the depth at which it was processed. A student generated analogy would be processed at a deeper level than a teacher generated analogy, because the individual would be required to go further, or deeper into the store in

order for the connections to be made. A teacher generated analogy might fail to make a connection simply because the information necessary was not present. The very fact that the students were required to make an analogy makes it more likely that the visual images were remembered because the connection between the new information and information in the long term memory store had been made. This depth of processing is also known as stimulus elaboration, (Craik & Lockhart) and it can be speculated that in the student generated analogy condition that this is exactly what the subject is doing -- embellishing the visual image with properties so that memory would be enhanced. Weinstein (1978) described the design of a Learning Activities Questionnaire that was administered to several learner populations. Results showed that the more successful learners from a wide range of populations used meaningful elaboration strategies, among them such strategies as visual imagery and the formimg of analogies.

Schema Theory

That information is accepted, held and processed at different levels in memory has been noted above. The way that knowledge is organized at these different

levels in memory can best be explained through schema theory.

To Rumelhart (1977), schema theory gives some of the answers to the following three questions:

1. How does an individual use old information so that new information can be acquired?

2. How is memory organized so that an individual can access required and relevant information?

3. How does the information that the individual presently possesses regulate action?

Pearson and Spiro (1982) in describing a schema in laymans' terms say that "...it's the little pictures or associations that you conjure up in your head when you hear or read a word or sentence." (p.46) They go on to add that "...it's an abstraction of experience that you are constantly fine-tuning and restructuring according to new information you receive." (p.47) Rather than just being present in memory as a basket of facts; knowledge is stored in memory structures known as schema. Anderson (1984) states that a schema ..."can be conceived as consisting of a set of expectations.

Comprehension occurs when these expectations are fulfilled by the specific information that a scene, message, or happening delivers to the senses." (p.5)

Rumelhart, (1977) likens a schema to a play. In this analogy the script of the play is the internal structure of the schemata. The particular enactment of the play is the particular instance of a concept. The roles that are filled by different actors for different performances of the play can be likened to the variables of the particular schemata. The characteristics with which the playwright endows the actors are likened to the information of types of objects that are bound to the various variables.

A schema can also be likened to a child's Russian Babushka doll, which opens to display another, slightly different doll, which also opens. Each subsequent doll is different from the one before, but they all are related to each other. A schema as described by Adams and Collins (1979), is a "...description of a particular class of concepts and is composed of a hierarchy of schemata embedded within schemata." (p. 3.) Schank and Abelson (1977) discuss the broad conceptual class that would be represented by a schema "going to a restaurant." The top level of the schema would include the information that a restaurant is an

establishment where one pays to have food prepared, served and cleaned up. It would include everything that the individual has experienced in restaurants. Embedded within this very general schema would be a more specific schema that would describe the type of restaurant, from a hot dog stand at a fair to a drive-through fast food chain establishment to a very expensive restaurant where a meal would take up extensive time and the eating of it would be an event in itself. The bottom most level of the "going to a restaurant" schema would include events and specifications that would apply to a single event. This could include a happening that was unique to a particualar establishment with certain individuals who were gathered together for a special occasion.

In summary, schemata are data structures for the generic concepts that are stored in memory. There are schemata for all of the generalized concepts that underlie objects, feelings, actions and events, and the sequences in which they come. They are fundamental to comprehension, and it is in this area that much research has taken place. Adams and Bruce (1980) used several fables to test the reading comprehension of adults and children. They concluded that comprehension is dependent on the use of prior knowledge or schemata, to create new knowledge, and that problems in this area

usually arise when a mismatch occurs between the author's expectation of the reader and the reader's actual knowledge.

Anderson (1977) suggested that students interpret passages through the use of schemata that allow them to understand and to cope with events. It can be speculated when students generate analogies on instruction so that they may remember visual images, the information from two sources satisfies expectations. These two sources would be

1. the analogy that is formed when the image is viewed

2. the suggestion it makes through its configuration to something already known to the student.

There would be no change to the necessary schema. It is likely that the image will be remembered. Students attempting this with a teacher generated analogy may have some difficulty. If there are gaps in the available information for whatever reason, the expectations may not be satisfied and the necessary schema would not be accessed.

In summary, when students use mental skills productively in learning, these skills are known as learning strategies.

Instruction can be designed to use either detatched or embedded strategies. As such, the instructional designer can make decisions as to which learning strategies to include in materials so that these materials are more likely to be effectively remembered. They can include mnemonic strategies as well as visual imagery.

Field Dependence/Independence and Flexible/ Constricted Control are examples of two cognitive styles that could have some implication for instructional purposes. The former involves the individuals' ability to perceive the world in either a global or analytical way, and the latter style involves the individuals' ability to resist cognitive interference.

In designing effective instruction, strategies that activate available schema could assist a student in processing information to a level in memory where it would not only be available for easy retrieval but would be resistant to forgetting.

CHAPTER III

METHODOLOGY

In this chapter the subjects, facilities and equipment will be described. This will be followed by an account of the lesson development, the test administration, the specific cognitive styles studied, and the testing procedures. The research design, the collection of data and the method used to analyze it will then be delineated.

Subjects

Subjects were fifty-six Grade Six students enrolled in a Calgary (Alberta) school. The area surrounding the school is almost exclusively middle class, having no low-cost or high-priced executive-type housing within the school boundaries. No student is bused in from other areas. Because the subjects are from one Socio-economic class, that of the middle class, this in itself was expected to control for SES bias that could have been encountered in a multi-SES school. The subjects were in three complete regular Grade six classes, engaged in the regular Grade six program of studies. Since students in this age group (eleven to twelve years old) are often expected to recognise and

name shapes, it was considered appropriate to select this population to teach the specific learning strategies that were used in the study.

Children of this age often exhibit an intense interest in something novel, and are generally confident in their school setting. The latter can be attributed to the fact that they are the eldest students in the school and enjoy working on an individual basis with personnel apart from their regular teachers. Such characteristics may well have contributed to making the students pliant subjects and does raise the issue of the Hawthorne Effect (Roethlisberger and Dickson, 1939) in connection with the study. However, a search of the literature indicated nothing to support any relationship between mnemonic strategies and the Hawthorne Effect.

Parents of each child were contacted by letter to seek permission for their child to participate, to explain the nature of the study, and to guarantee anonymity. (A copy of this letter is included as Appendix A.) No rewards were given for participation in the study.

The researcher discussed the general purpose of the study with each class as a whole. Only enough information was given to help subjects understand what

they would be doing without providing too many cues that may have introduced bias. It was explained that a study was being conducted on remembering shapes but there was no reward or "best" answer. It was emphasized that all student effort was of value and greatly appreciated. A transcript of this address to the students went as follows:

> I am very interested in how people like you remember things. Your class will be divided into three groups, and I will work with you individually. I will use a couple of interesting "no - wrong - answer " tests to find out some things about you. Later I'll get you to view some slides. I'll be back in a week to see you again. Just as some people have individual taste in ice cream flavors, so they also have individual ways of remembering things. I will appreciate all your efforts."

After the subjects had been randomly assigned to one of the three groups, they were withdrawn individually by the researcher to proceed with the collection of the personal data of age and sex and to administer the Stroop Color Test and the Childrens'

Embedded Figures Test. These tests are discussed in length later in this chapter.

Facilities and equipment

Individual testing and procedures were carried out in a small room separate from the class. The room was located at the end of a hallway away from the heavier traffic areas. Bookcases in the viewing area of the subjects were rearranged to remove potentially visually stimulating materials. Each condition required the use of a slide projector and individual screen, and a tape recorder. The subjects operated the slide projector so that they could proceed at their own rate, but the researcher operated the tape recorder. The subjects were informed that each condition was timed. Instructions were put on tape to ensure that each condition received the same materials. It was felt that operating both projector and tape recorder could be potentially distracting for the student. Student comments were recorded on the data sheet. Lighting was adequate and there was no distracting glare. The project was carried out during school operation hours, and the room was isolated enough so that there was no distracting noise. No student was asked to participate during recess, lunch or after school hours.

Using this method, only one subject was absent from the class at any one time. This cut classroom disruption to a minimum and yet allowed for the project to continue. At no time could subjects copy each others' work, though there was, of course, the danger of the subjects discussing the project during out of school hours. It was not emphasized that subjects not discuss the project for fear of producing the opposite result. Each subject was seen by the researcher on three separate occasions, once for personal data collection and cognitve style testing, once to administer the Learning Strategies materials, and once for testing. Total time was less than 45 minutes in all cases.

Analogy Learning Strategy Lesson Development

Two learning strategy lessons on analogy learning had been developed and tested. These and the control lesson contained the same stimulus material but different instructions for use. The stimulus material was a series of shapes, similar to those used by Rorschach (1942).

The decision to use Rorschach-type ink blots as stimulus material was made for four reasons.

1. It was predicted to be motivational. Rorschach (1942) showed that this type of material was able to elicit extensive responses with minimum prompts required from the researcher.

2. Rorschach pointed out that symmetry makes conditions the same for both right-handed and left-handed subjects.

3. Rorschach also noted that asymmetrical figures are rejected by many subjects.

4. It would closely simulate the type of learning task often required of students in a school setting - such as learning to recognise the shape of countries or the silhouette of science equipment.

The ink blots were produced by dropping three drops of black ink onto half a sheet of paper. The paper was then folded and pressure applied to spread the ink. The figures that were selected were done so because they appeared to be relatively simple. The selected blots were photographed to bring them to an approximate uniform size and color density and to make them available in a slide format. Kodak ASA 100 Slide film was used.

From a pool of forty blots, seventeen were randomly selected for use for the treatments. Two were used as practice materials, and fifteen were used for the treatment. From the remaining twenty - three, a further ten were randomly selected for use for test purposes. The order of presentation for the test was also randomly chosen. Thus each condition had the same two practice slides, and fifteen slides as stimulus material. The test contained ten of the practice originals, randomly chosen, and ten new shapes.

An audio tape was made to accompany each condition. A copy of the condition and test transcripts can be found in Appendix B.

Test Administration

All tests and procedures except for the initial group introduction and explanation were administered individually by the researcher. A field test using seven Grade six children from schools not involved in the study was conducted to estimate times for project administration and to familiarize the researcher thoroughly with the tests and learning strategy materials.

Though the main interest in this project was to observe the effectiveness of teacher or student

generated analogies, two cognitive styles were also tested for, to determine if there were any interactions between them and analogy source. The Stroop Test and Children's Embedded Figures Test (CEFT) were administered, followed by the analogy strategy learning practice and trials. The Stroop Test is commonly used to test for Constricted/Flexible cognitve style, which involves the differences in focussing on a central task and the ability to withhold attention. The CEFT is used to test for the cognitive style of Field Dependence / Independence, which involves differences in experiencing items as discrete from their background, and the tendency to perceive a perceptual field either globally or analytically. Rather than use one of the other tests that were described in the Literature Review of Chapter 11, the CEFT was used because it does not put the subjects under any time pressure, and could be administered individually.

The Children's Embedded Figures Test

The CEFT was administered in a small room that was later used for teaching and testing the analogy learning. The researcher sat opposite the subject and displayed the color plates one at a time. The test series contained 13 practice items and 25 test items. Subjects were required to find a given figure hidden in

a complex design and their ability to do so was recorded on a recording sheet. Testing was stopped after five consecutive failures. Responses were scored 1 or 0. A score of 1 was given only when the first choice was correct and verified, as in the CEFT Manual. The total score equaled the number of items passed, 25 being the maximum score.

Stroop Test

The version of the Stroop Test that was used in this study incorporated four colors - red, green, blue and orange. A 14" x 22" sheet of paper was divided into 52 rectangles, each approximately 1/2 inch high and 2 1/2 inches long. The rectangles contained the colors mentioned, and at no time was the same hue adjacent in the same horizontal line. Another sheet was initially prepared in the same manner, but the rectangles contained the color names printed in different hues, for example, the word "red" was printed in blue ink. At no time were the same colors adjacent in the same horizontal line. At the bottom of each sheet the word STOP appeared.

The subjects were seated opposite the researcher, facing the covered colored rectangles sheet. In order to make sure that each subject could actually read the color names used, they were first tested in this

procedure. A set of 2 1/2 " x 6" cards were prepared. Four contained the color names in colors of a different hue, and the other four had rectangles of the actual colors on them. It was explained to the subject that they would first be required to name the colors, and after a rest would be required to read the color of the ink of the words beginning at the top left corner. They were told that they would be timed, and were encouraged to do the task as quickly as possible and to read the word STOP when they came to it.

The cover over the first test sheet was removed, the subject gave the color names and the time was recorded. After a thirty second rest period, the second stimulus sheet was presented. The subjects were reminded that this time they would be required to read the color of the ink. Again the time was recorded. The difference between the two times was treated as the measure of susceptibility to cognitive interference.

Experimental Treatment

After the cognitive style testing, the training in the learning strategy started.

Forty shapes were originally produced, using the technique previously described. Of these, two were used as practice items, and fifteen were chosen to view and

remember as treatment material. On the test, given one week later, ten of these were chosen as test material, together with ten more that had not been previously viewed. All twenty seven were randomly chosen from the original set.

For the actual training, a slide tape projector was positioned with an individual viewing projector. A tape recorder was used for giving instructions. Though the subjects were not specifically asked to verbalize during their time with the researcher, anything that the subject said was recorded on the data sheet for later checking with the test answers.

Treatment One

Tape one, used by the control group, asked the subject to proceed to slide one by pressing the forward button. The subjects were asked to use any method they wished to remember the shape of the blot on the screen. When each shape was learned to the subject's satisfaction the tape instructed the subject to press the advance button to the next slide. At this point, when the new slide was able to be viewed, the researcher activated the tape, which would repeat the instruction to learn the shape in any way they wished. The task was administered in this way so that subjects could proceed at their own rate.

Treatment Two

Tape two, used by the teacher generated analogy group, gave an analogy for each slide. For example, on proceeding to slide one the tape said,

> Look at the shape before you. It looks like two women gossipping. See their hair style?

At this point the researcher stopped the tape and outlined features of the shape on the screen. The tape proceeded when the subject indicated that the association between the analogy and the shape had been made, and went on to the next slide. The tape was then restarted by the researcher and the next practice analogy given. When the subject indicated that the second analogy was understood, and turned to the first treatment shape, the researcher proceeded with the accompaning audio tape.

Treatment Three

Tape three, used by the student generated analogy group, asked the subject to generate an analogy for each slide that was viewed. As with the teacher generated analogy group, the researcher operated the tape recorder. As each slide was viewed, the tape would say the following, or words to this effect.

> Look at the shape. Think of something that this shape reminds you of. See the thing that you have chosen in this blot. When you have finished, press the forward button to the next slide.

The actual words varied slightly, with different vocal emphasis put on different words, but retaining the same meaning. This helped to slow subjects who may have been inclined to flick through the slides to focus on the shapes and the task that was presented to them.

Test

Testing for remembering shapes was conducted one week after the initial training and treatment. It was felt that this would give enough time to show if the analogies were indeed effective.

All subjects listened to the following transcript on tape. The test was timed. Subjects operated the slide projector with the remote control and the researcher operated the two tape recorders. One recorder gave the subject instructions, and the other recorded anything that was said.

> Hi there. Last week we looked at some slides, and you were asked to remember them in a certain way. I said that different people remember information in different ways, just as people have different tastes in ice - cream. Think hard to remember the way that you were asked to remember in. You tell me if you have seen the shape on the screen before today. If there is something about that shape that helps you to remember it, then please tell me. I'll write dowm your answers because I'll be very interested in them. You have plenty of time. You can operate the remote control button, so that you need not feel that you have to rush. Whenever you are ready, you may begin.

In this manner the project conditions were conducted. Because the material was in tape and slide format, maximum flexibility was obtained in administering the project.

Data Recording

As the subjects were assigned to a condition they were given a number, one (control group) two (teacher generated analogy group) or three (student generated analogy group). They were also assigned an

identification number, all of which was recorded on a master sheet and on subsequent materials. Sample Data Collection sheets are to be found in Appendix D. The master sheet was initally kept separate from the data sheets, and was destroyed as soon as the final results were calculated. In this way results from Cognitive Style tests could be matched with individual condition or control results. The subjects were not informed as to the condition number nor as to the identification number that had been assigned to them. The gathering of personal data such as age and sex was also used as a method of gaining familiarity and rapport between the researcher and the subject.

Data Analysis

The data collected included the subjects' CEFT and Stroop scores, age, sex, and treatment scores. The tests to be used to analyze the data were a T-Test -- Sex by CEFT, an Analysis of Covariance -- Score by Group with Treatment Time, Test Time, Stroop Scores, CEFT scores and Age, Pearson Correlation Coefficients, and an Analysis of Variance -- Score by Group, Stroop and CEFT.

Summary

In summary, a special instrument was constructed for testing for memory. This consisted of forty ink - blot shapes that were produced on slide, twenty seven of which were subsequently displayed on an individual slide viewer. Those subjects randomly assigned to the first condition, or control, were asked to view shapes and to remember them in any way that they wished. In the second condition, subjects were trained in use of the Learning Strategy that used Teacher Generated Analogies as the mnemonic with which to rememeber the shapes. The third condition trained the subjects to form their own analogies after viewing the shapes. The test that was developed to judge how effective the different sources of strategy were used a number of previously-seen and never-seen shapes. The subject was required to say if the shape had been previously seen, and to verbalise the strategy that had been used for remembering.

The number of those shapes recognised after one week was used as the measure of memory. It was decided that a score of 80% or better on the test would be an indication that the shapes had been remembered at an effective level. The same percentage correct (80%) was decided as being acceptable for a match of the analogy

given by the subject at the time of treatment and again at the time of the test. In addition, sex and age were noted. The CEFT was used to measure how Field Dependent or Independent the subjects were and the Stroop Test measured the individuals' level of Constricted or Flexible Control. A full description of the analysis of the data collected follows in Chapter Four.

CHAPTER IV

RESULTS

Introduction

This chapter will describe the data that were collected and analyses performed to test the hypotheses of the study. In general it was found that subjects did use analogies as a learning strategy. The data related to testing the effectiveness of the origins of these analogies, however, proved inconclusive.

Description of Sample

Age and Sex. Fifty-six subjects participated, ranging in age from 135 months to 155 months. This indicated that all participating subjects were within the usual age range for this grade, with no subjects who had repeated the grade and none who had been accelerated. Twenty-four males and 32 females took part and were distributed among treatment and control groups as noted in Table 4.1.

Table 4.1

Distribution of Sex within Groups

Groups	Male	Female	Total
Control	8	11	19
Teacher Generated	8	11	19
Student Generated	8	10	18
	24	32	56

Stroop. Scores on the Stroop test across all groups ranged from 10.00 to 78.00 with a mean of 39.250 and a standard deviation of 15.304. (See Table 4.2.) (A high score on the Stroop test indicates a more flexible cognitive style whereas a low score indicates a more constricted style. A high score (flexible style), therefore, is an indication of more susceptibility to distraction and cognitive interference. Conversely, a low score, an indication of a constricted style, indicates an individual actively inhibiting competing learned responses.

Children's Embedded Figures Test Scores on this test across all groups ranged from 4.00 to 24.00 with a mean of 15.161 and a standard deviation of 4.434. (A high score on the Children's Embedded Figures Test (CEFT) indicates a Field Independent individual who approaches the world in a more analytical way than the Field Dependent individual. Field Dependent individuals approach the environment in more global terms. A Field Dependent individual receives a lower score on the CEFT than a Field Independent individual.

Percent of Figures Recalled The chief dependent variable used in the data analysis as the indication of the ability to recall figures was the score obtained on the post test. This test score was the percentage of shapes that were verbally indicated by the subject as having been seen or not been seen before, and will hereafter be referred to as the Score. Scores across all groups ranged from 55.00 to 100.00 with a mean of 82.232 and a standard deviation of 9.673.

Number of Analogies Recalled A second dependent variable was the number of analogies the subject could remember that matched with the student-generated analogy or the teacher- generated analogy. These were given by either the teacher or the student at the time of treatment. Hereafter this will be referred to as

Match. An answer was regarded as a match if the same description was given for the figure on the test as was given during the treatment. If a subject gave more than one analogy for a figure, as long as one of the given analogies matched with the treatment analogy, then it was considered that a correct answer had been given. Match scores across all groups ranged from 10.00 to 100.00 with a mean of 53.679 and a standard deviation of 19.810.

Times Recorded The time that each individual took to complete the treatment and then the test was recorded in seconds. All subjects had been informed that they would be timed. It was stressed by the researcher that subjects could take whatever time they required to complete the task. Treatment times across all groups ranged from 143 to 649 seconds with a mean of 288 and a standard deviation of 129 seconds. Test times ranged from 95 to 436 seconds with a mean of 194 and a standard deviation of 70 seconds.

Table 4.2

Descriptive Statistics

	Mean	SD	Min	Max	Range
Stroop	39.250	15.304	10.00	78.00	68.00
CEFT	15.161	4.434	4.00	24.00	20.00
Score	82.232	9.673	55.00	100.00	45.00
Match	53.679	19.810	10.00	100.00	90.00
Cond.Time	288.200	129.512	143.00	649.00	506.00
Test time	194.000	70.095	95.00	436.00	341.00
Age	142.480	5.849	135.00	155.00	20.00

Test for Possible Effects of Sex

The data were first examined for possible effects of sex on score. This was done so that a decision could be made as to whether sex should be considered as a variable of interest in later analysis. A search of the literature had shown that sex might be related to differences in CEFT scores. (See Chapter 11, p42.) In the event that an effect was found for CEFT, sex would be a rival hypothesis.

A one-tailed t-Test was conducted to determine if there was a main effect for sex on score. $t(54)=-0.60$ $p=>.27$, one-tailed.

Check for Sex as a Main Effect

Table 4.3

T-Test - Sex by CEFT

	Male		Female			
	X	S.D.	X	S.D.	t*	p
Score	14.750	4.455	15.468	4.465	-0.60	.27

* = one-tailed.

The difference in score means did not approach significance (p=>.27), the actual difference in means being (1.625 and 1.375). Therefore it was judged that sex warranted no further consideration as a possible main effect.

Test for Hypothesis One

H1: Analogy learning is an effective learning strategy for all students to remember visual images.

For effective learning to be judged to have occurred, it was necessary for subjects to have obtained a minimum score of 80% and a minimum match of 80%. (See Chapter 111, p.72) Table 4.2 shows a mean score of 82.232 across all groups with a standard deviation of 9.673. On reading the test protocols and

listening to the tape of subject test answers it was discovered that almost all students, including the control group, used analogies when learning the shapes. Furthermore, there appears to be evidence that the shapes themselves were remembered better than the analogies. Table 4.2 gives the distribution of the match. The mean match of 53.679 with a standard deviation of 19.810 indicated that students did not remember analogies at the same level of effectiveness that they remembered the shapes. That students remembered the visual images is clear, but the data for whether or not analogies were effective as a learning strategy are inconclusive.

Test for Main Effect of Treatment. Hypothesis Four.

H4: Students generating their own analogies remember more than those students who are told analogies by the teacher.

To test for main effect of group (the origin of the analogies) on score, an Analysis of Covariance was performed using score as the dependent measure, group as the independent measure, and condition time, test time, Stroop scores, CEFT scores and age as covariates. The Analysis of covariance in Table 4.4 shows there is no main effect between group and the dependent measure of score. $F(2,48)>.7$. Eight cases of missing data

account for the total DF=47 rather than the expected 55.

Table 4.4

Analysis of Covariance - Score by Group with Treatment Time, Test Time, Stroop scores, CEFT scores and age

Source	Sum of Squares	DF	Mean Square	F	F Prob.
Covariates					
Cond.Time	463.636	1	463.636	6.115	0.018
Test Time	11.011	1	11.011	0.145	0.705
Stroop	408.098	1	408.098	5.382	0.026
CEFT	46.365	1	46.365	0.611	0.439
Main Effects					
Group	56.189	2	28.095	0.371	0.693
Explained	1215.048	7	173.578	2.289	0.046
Residual	3032.869	40	75.822		
Total	4247.917	47	90.381		

However, effects which were not hypothesized did appear for three covariates: condition time, F(1,40) p=0.0475, Stroop, F(1,40) p=0.045, and age, F(1,40) p=0.046. This would seem to indicate that the time that a subject spends with the stimulus material is an

important factor, as is the subjects' susceptability to cognitive interference (constricted/flexible). Results indicate that the age of the subject seemed to have an effect, but as was discussed earlier, the age range of the sample seemed too small for this to be of research importance in this study.

In order to discover the nature of the relationships between time, Stroop, age and score, Pearson Correlation Coefficients were calculated. Negative correlations were noted for both Stroop (r=-.2292) and age (r=-0.2270). (See Table 4.5). Time proved to be positive (r=0.2392). As such, Hypothesis Four cannot be supported.

Table 4.5

Pearson Correlation Coefficients

		Score.(r)
Name	Stroop	-0.2292*
	Age	-0.2270*
	Time	0.2392*

* p<.05

Test for Hypothesis Two

H2: There is no interaction between cognitive style and source of analogy on the effectiveness of analogy learning.

An Analysis of Variance (ANOVA) was then performed. (See Table 4.6). Artificial dichotomies were created for Stroop and CEFT by splitting each into two groups at the mean. (To create groups two standard deviations each side of the mean left too few scores to conduct an analysis.) There were no interaction effects noted, which supports the hypothesis.

Test for Hypothesis Three

H3: Students will use analogy learning strategies after being instructed to do so.

Anecdotal records support this hypothesis. While all students in the teacher-generated and the student-generated groups used analogies, 14 of the possible 19 subjects in the control group also gave analogies to the researcher as their chosen method of remembering the shapes. The remaining five subjects did not choose to tell the researcher how they remembered the shapes.

Table 4.6

Analysis of Variance - Score by Group Stroop and CEFT

Source	Sum of Squares	DF	Mean Square	F	F Prob
Main Effects					
Group	6.988	2	3.494	0.036	0.964
Stroop	291.724	1	291.724	3.038	0.088
CEFT	46.272	1	46.272	0.482	0.491
2 - Way Interactions					
Group x Stroop	234.961	2	117.480	1.223	0.304
Group x CEFT	49.191	2	24.595	0.256	0.775
Stroop x CEFT	18.663	1	18.663	0.194	0.661
Residual	4225.625	44	96.037		
Total	5145.982	55	93.563		

Summary.

In summary, two of the hypotheses, Number Two and Three, were supported by the data. The former hypothesized that there would be no interaction between cognitive style and source of analogy on the effectiveness of analogy learning. As was previously stated, cognitive style refers to the way in which information is acquired and processed. It does not refer to the amount of information that an individual perceives nor does it refer to the ability of an individual. Though a main effect was noted for Stroop, no interaction between cognitive style and Group was found. It had also been expected that subjects would use analogies as a learning strategy. This was borne out by the anecdotal records which showed that almost all subjects did so, even many of those in the control group who had not been specifically instructed to use them.

Two of the hypotheses could not be supported. Both Hypothesis One and Hypothesis Four concerned the effectiveness of analogies as a learning strategy.It could not be proven that the learning strategy was effective for all subjects. Subjects remembered the visual images, as was hypothesized, but the study did not prove that the subjects used analogies to remember

the visual images. Subjects did not achieve match of shapes and analogies at the pre-set level that was necessary for effective learning of the shapes to be judged to have occurred. No one group was proved to have achieved significantly higher scores than any other group. That there was no significant difference among scores of the groups was treated as an indication that there was no difference in the effectiveness of the source of the analogies.

Speculation regarding the unanticipated effects of time and Stroop on score and some possible reasons for the afore-mentioned findings will be addressed in Chapter V.

CHAPTER V

CONCLUSIONS

The purpose of this exploratory study was to test the effectiveness of the origins of analogies as a learning strategy for remembering visual images. The cognitive styles of Flexible-Constricted Control and Field Dependence-Independence were taken into account.

A Learning Strategy lesson for two treatment groups was developed. Individuals in a third group were instructed to choose their own strategy. Individual subjects in the three groups were presented with the same materials - visual images of symmetrical ink blot shapes in slide format projected onto a screen. Subjects were 56 students enrolled in the regular Grade 6 program of studies in a middle class suburban Calgary Elementary School. Prior to the experimental treatment, subjects were tested for the Cognitive Styles of Flexible/Constricted Control and Field Dependence/ Independence using the Stroop test and CEFT respectively.

Discussion of Results

The results of this exploratory study indicated that neither treatment had any significant effect on

test scores. The results also indicated that while the cognitive style of Field-dependence/field-independence showed no interaction with test scores, the cognitve style of Flexible/constricted control did have an effect on test scores. Further data analysis indicated that while the source of the analogy made no difference as to how effectively the shapes were remembered, the amount of time that was taken to complete the treatment appeared to have an effect.

One of the unexpected observations of the study noted by examination of the anecodotal records was that all but five of the 19 subjects in the control group, when asked to learn the material in any way that they wished, also used analogies as a learning strategy. This raises the concern that there was no effective control group, as the control group used the same mental skill as a learning strategy as did the other two treatment groups, even though the control group employed it with no prompting at all.

There was no interaction effect found between Stroop and score but there appeared to be a significant main effect found for Stroop on score. Literature studied in conjunction with the study had indicated that Cognitive Styles were concerned with the manner and form of cognition, rather than with specific

abilities. The finding of this exploratory study that individuals who displayed a more constricted cognitive style would be more likely to remember visually presented shapes was not anticipated.

Though a high percentage of subjects recalled seeing the shapes previously, few could give the correct analogy that would match the shape. However, on being presented with the shapes during the test, anecdotal records showed that many subjects, though they could not recall the correct analogy, gave a new analogy on viewing the previously seen shape. Where subjects correctly matched the previously given analogy with the prevously-seen shape, it might be possible that it was the visual image that recalled the analogy rather than the analogy that recalled the visual image. It had been hypothesized that on the test the subject would view a shape, recognise through the analogy the visual image that the shape suggested, and would in turn recall having previously seen the shape. However, a study of test protocols revealed that on viewing the shape, subjects indicated that the shape had or had not been seen before, then either gave an incorrect analogy or no analogy at all. It can therefore be suggested that the analogy and the shape are not necessarily processed simultaneously, nor are they stored simultaneously in Long Term Memory. Though studies back

to the time of Simonides (Chapter 1, p.7,) have shown the beneficial role visual learning takes in the general acquisition of some knowledge, the use of the verbal mode for visual learning is not necessarily as effective.

It can be concluded from this that it is not so much the source of the analogy that has an effect on how well it is remembered, as the time a subject spends looking at the shape on the screen and the individual's susceptibility to cognitive interference. An individual's restriction of cognitive attention seems to make it easier for the image, i.e. the shape, to be processed at a level where it can later be retrieved. It had been hypothesized in this study that visual learning would be enhanced by using analogy generation as a learning strategy. This has been supported but it appears that a subject must spend extra time in order for the elaboration process to take place. Craik and Lockhart (1972), stated that more elaborate, longer lasting and stronger memory traces are associated with deeper levels of analysis. This leads to the supposition that the visual images presented in this study were retained at a different depth in memory than the analogies, regardless of the origin of those analogies. Craik and Lockhart (1972) state that

> retention of any material is a function of depth and various factors, such as the amount of attention devoted to a stimulus, its compatability with the analyzing structures and the processing time available. (p.676)

In this study it was those subjects who spent the most time with the stimulus material who received the highest scores on the test. This is consistent with the Craik and Lockhart findings. Though Craik and Lockhart go on to say that verbal materials such as sentences are also relatively easy to retain in memory because they are meaningful and so can be processed to a deep level more quickly than less meaningful materials, it can be speculated that subjects, on being presented with visual and auditory materials simultaneously, chose to give more attention to the visual materials rather than the auditory materials. The ease of retrieval of items in memory could also have been the determining factor that decided which mode (the visual or the verbal) was more easily recalled.

It could also be speculated that though both the visual and auditory stimuli that were presented were processed to a deep level in long term memory, the visual stimuli were more effectively stored in and retrieved from long term memory. (Paivio, Rogers and

Smythe 1968). It could be theorized that the shapes that were presented to the subjects initially were meaningless until the subjects were either given an analogy, as in the Teacher Generated Analogy Group, or made up an analogy, as in the Student Generated Analogy Group. The meaningless shapes then took on all the properties of a picture, and from there on would have been treated by the subject as a picture. Dallett and Wilcox (1968), Paivio, Rogers and Smythe (1968) and Standing, Conezio and Haber (1970) in several studies all proved that recall of visual materials such as pictures is higher than recall of verbal materials. It could be surmised that the function of the analogies was to manipulate the shape into becoming a meaningful picture, and the shape would thereafter be processed and remembered at a rate as if it were a picture, and as such would arouse a concrete image. This would account for the high recall of the shapes, which was compatable with that found by Shepard (1967).

In theorising why the shapes were learned more effectively than the analogies, the work by Craik and Lockhart (1972) into the theories of depth of processing could provide some explanations. Both the visual and verbal materials would be held in the Short Term Memory Store (Craik and Lockhart) until the subject made the connections between the analogy and

the shape, which would then become a "picture" as described above. Once the connections had been made, the visual material would enter the Long Term Store, reinforced, as it were, by the verbal material. The analogy could have acted as a rehearsal for the shape, which would have been processed twice - once visually, and once verbally. The reverse would not necessarily have been true for the analogy, which, once having facilitated the movement of the shape into the long term memory store, did not itself leave the short term store, and without the required ongoing attention, was soon forgotten.

Speculation as to why those individuals exhibiting constricted control as determined by the Stroop test were more likely to learn the shapes is more difficult.

A second search of the literature failed to disclose any studies that give any indication that constricted-flexible control is related to specific abilities (Kogan, 1971). A thorough review of the present study's procedures failed to disclose any indications as to why those students who were more able to actively inhibit learned responses (constricted control) were more likely to recall the visual images.

It had been speculated that the origin of the analogy would have an effect on the score. Those

subjects who were required to generate their own analogies were expected to be able to recall more shapes because they would have been required to connect the shape with information already in existing schemata. (Rumelhart and Norman, 1977.) If this had been so, accretion learning should have taken place, which occurs when new information is taken into exsisting schemata. It usually involves much fact type learning that occurs. Anderson (1984) takes the position that learning is slowed down or does not occur if information is not assimilated into a schema. In the present study the shape was presented visually and then the subjects either heard or produced their own analogies to go with that shape. A search of the anecdotal records failed to show any subjects at any time who stated that they did not either understand the task or did not "see" the picture that the shape suggested. It could be assumed then, that the information that was presented both visually and verbally <u>was</u> assimilated into available schemata. In order to retrieve each, the individual would have to "search", as it were, two different schemata.

That the shapes were recalled and not the analogies could maybe have been due to the fact that on the test the subjects were required to perform two quite different tasks for shape recognition and analogy

recall. In order to get a correct answer on the shape recognition section, all that was required was a Yes/No response. However, in order to get a correct answer on the analogy section, the subject was required to recall the actual analogy or something close to it. The former was a recognition only task, the latter a task that required the actual construction of semantic material.

The study set out initially to be an exploratory study into the effectiveness of the origins of a specific learning strategy. Subsequent analysis shows that though analogies were proven to be generally an effective learning strategy, the effectiveness of the origins of these analogies remains inconclusive.

Further research questions and some research recommendations

The study raised several questions which could be investigated in future studies.

1. Is the cognitive style of flexible/ constricted control affected by small variations in age?

2. Is there any relationship between clearly differentiated constricted flexible control cognitive style and the ability of individuals to recall visual images?

3. What is the amount of time on task needed for effective learning of visual images?

4. Can the relationship between visual and verbal processing be delineated?

5. In what ways can visual processing aid verbal processing and visa versa?

Further investigation into Constricted/Flexible Control as a cognitive style seems to be warranted. The finding in the present study that individuals displaying constricted control were more likely to recall the shapes is contrary to the information discussed in Chapter 11, p.36 There it was suggested

that a particular cognitve style did not have to do with the ability of an individual and there was no indication that Flexile/Constricted Control was affected by age. Researchers such as Coop & Brown (1970) and Grieve & Davis (1971), using a median split of scores from the Group Embedded Figures Test (GEFT) failed to show any interaction between methodology and cognitive style. A larger sample might allow for a study of those individuals whose Constricted/Flexible Control scores fall two standard deviations from the mean. Greco and McClung (1979) isolated extreme analytical or global styles using scores two standard deviations from the mean using the Group Embedded Figures Test. They found a significant difference in the performance of subjects displaying extreme cognitive style when using certain instructional techniques. Similar studies could be conducted using other cognitive styles, in particular flexible/ constricted control with the effectiveness of certain types of visual images as the dependent variable.

A study similar to the present one with time given for learning visual images controlled would answer some of the queries regarding time. Constricted/ flexible control could also be a variable.

The present study showed a slight negative correlation for age and score (r=-0.2270). The subjects used in this study were all from Grade 6, none who had been accelerated or who had repeated a grade. There was less than two years age difference between the eldest and youngest subject. As such, it was difficult to draw conclusions concerning age with such a narrow sample. A study using subjects from a greater age range, for example a group from Grade 3 and a group from Grade 6, using age as an independent variable and appropriate visual materials suitable for both groups could provide data that would allow for more confidence in drawing conclusions regarding the effectiveness of visual materials for different age groups.

A two alternative forced choice test (Shepard and Chang, 1963, Standing, Conezio & Haber, 1970) would control for some potential bias in the "Yes/No" answer form that was administered in this study. A new shape would be presented alongside one of the previously seen shapes. Shapes would be randomly set to the horizontal right or the left of each other. Subjects would be required to make a decision as to which shape had been previously presented and then give a reason for their choice.

In order to be able to design effective materials, instructional designers require reliable information as to the most effective learning strategies to use under certain conditions. This present study noted that subjects can effectively recall visual materials, but do not necessarily use verbal materials such as analogies to do so. The materials that were required to be recalled in the present study did not require extensive learner analysis. The visual images were expected to be assimilated into the learner's schemata that was already present. The recommendation for instructional design could be that given a task where recall only of a visual image is required, extensive analogy generation is not necessary.

For teachers who are most likely to be responsible for the administration and adaptation of instructional design materials, the present study may confirm some intuitive knowledge, or add to that already known. This would include the following.

1. Individual differences in a learners' cognitive style such as flexible/constricted control may have an effect on how effectively some visual materials can be recalled.

2. Those learners who spend more time with instructional materials that include visual materials are more likely to recall those images.

3. In practical classroom application, the learning of visual materials could extend to recognising the different types of bird beak, the general shape outline of different classes of tree, the silhoutte of different classes of airplane, or the shape of animal tracks to name a few.

In conclusion, requesting that learners generate analogies or use those supplied by the teacher or the instructional material in order that visual materials be recalled may not be the best use of student or teacher time. The present study showed that the amount of time that the subject spends with stimulus material is the factor that is most likely to assist the subject in recall of simple visual materials. It would be the task of the instructional designer then, to build this extra time factor into instructional materials.

BIBLIOGRAPHY

Adams, M. & Bruce, B. Background knowledge and reading comprehension. Reading Education Report No. 13. B.B.N. Report No. 4231. Bolt Beranek and Newman Inc. Cambridge, Massachusets, 1980.

Allington, R.L. The reading instruction provided readers of differing reading abilities. Elementary School Journal, 1983, 83, 548 - 559.

Anderson, R.C. The notion of schemata and the educational enterprise: general discussion of the conference. In Anderson, R.C., Spiro,R.J., & Montague, W.E. (Ed.) Schooling and the Acquision of Knowledge, Hillsdale, N.J.: Lawrence Erlbaum Associates, 1977.

Anderson, R.C. Some reflections on the acquisition of knowledge. Educational Researcher. 1984, 13, (9), 5 - 10.

Anderson, R.C. Spiro, R.J. & Anderson, M.C. Schemata as scaffolding for the representation of information in connected discourse. American Educational Research Journal, 1978, 15, 433 - 440.

Ausburn, L.J. & Ausburn, F.B. Cognitive styles: Some information and implications for instructional design. Educational Communication and Technology Journal. 1978, 26, 4, 337 - 354.

Ausburn, F.B. & Ausburn, L.J. Visual analysis skills among two populations in Papua New Guinea. Educational Communication and Technology. 1983, 31, 2, 112 - 122.

Collins, J. Discourse style, classroom interaction and different treatment. Journal of Reading Behavior. 1982, 14, 429 - 437.

Coop, R.H. & Brown, L.D. Effects of cognitive style and teaching method on categories of achievement. Journal of Educational Psychology, 1970, 61, 400 - 405.

Craik, F.I.M. & Lockhart, R.S. Levels of processing: A framework for memory research. Journal of Verbal Learning and Verbal Behavior. 1972, 11, 671 - 684.

Cronbach, L.J., & Snow, R.E. Aptitudes and Instructional Methods. New York: Irvington, 1977.

Dallett, K. & Wilcox, S.G. Remembering pictures vs remembering descriptions. Psychonomic Science, 1968, 11, (4), 139 - 140.

Dansereau, D. The development of a learning strategies curriculum. In O'Neil, H.F. Learning Strategies. Academic Press, New York. 1978.

Gagne, R.M. The conditions of learning. Holt, Rinehart and Winston, Inc. New York. 1965.

Gagne, R.M. & Briggs, L.T. Principals of Instructional Design. New York, Holt Rinehart and Winston, Inc. New York, 1979.

Galton, F. Inquiries into human faculty and its development. London: Macmillan, 1883.

Glaser, R. General discussion: Relationships between apitude, learning and instruction. In Snow, R.E., Federico.P.A., & Montague W.C. (Eds.) Aptitude learning and instruction. Erlbaum Associates. Hillsdale. N.J. 1980.

Gomulicki, B.R. The development of the present status of the trace thoery of memory. British Journal of Psychology. Monograph Supplement, 1953, No. 29.

Greco, A.A. & McClung, C. Interaction between attention directing and cognitive style. ECTJ, 1979, 27, 2, 97 - 102.

Grieve, T.D. & Davis, J.K. The relationship of cognitive style to performance in ninth grade geography. Journal of Educational Psychology, 1971, 53, 110 -118.

Groninger, L.D. Mnemonic imagery and forgetting. Psychonomic Science, 1971, 23, (2), 161 - 163.

Harrison, R.E. Education and Business: A logical partnership. Alberta Teacher's Association Magazine. 1984, Nov./Dec. 4 - 7.

Hawkins, P.R. Social class, the nominal group and reference. Language and Speech, 1969, 12, 125 - 135.

Jensen, A.R. & Rohwer, W.D. Jr. The Stroop color-word test: A Review. Acta Psychologica. 1966, 25, 36-93.

Kanata Kits. Department of Education, Alberta. 1980.

Knowlton, J.A. On the definition of "picture." AV Communication Review. 1966, 14, 157 - 183.

Kogan, N. Educational implications of cognitive styles. In Lesser, G. Ed. Psychology and Educational Practice. Glenview, Ill.: Scott Foresman and Co. 1971.

Kogan,N. Cognitive Styles in Infancy and Early Childhood. Lawrence Erlbaum Associates. Hillsdale, New Jersey. 1976.

Kosslyn, S.M. Image and mind. Harvard University Press, Cambridge. 1980.

Levin, J.R. Dretzke, B.J. McCormick, C.B. Scruggs, T.E. McGivern, J.E. & Mastropireri, M.A. Learning via mnemonic pictures: Analysis of the presidential

process. Educational Communication Technology Journal. 1983. 31. 3. 161 - 173..

Luce, R.D. A threshold theory for simple detection experiments. Psychological Review. 1963, 70, 61 - 79.

Messick, S. Personality consistencies in cognition and creativity. In Messick, S. and Associates, Individuality in Learning. Jossey - Bass. San Francisco, California. 1976.

Norman. D.A., Gentner, D.R. & Stevens, A.L. Comments on learning schemata and memory representation. In D. Klahr (Ed.), Cognition and Instruction. Hillsdale, N.J.: Lawrence Erlbaum Associates, 1976.

Osser, H. Cognition, Language development in children. In Lesser, G.S. (Ed.) Psychology and Educational Practice. Scott Foremen and Co. Illinois, 1971.

Paivio, A. On the functional significance of imagery. Psychological Bulletin, 1970, 73, 6, 385 - 392.

Paivio, A. Imagery and Verbal Processes. 1971. Holt Rinehart and Winston, Inc., New York.

Paivio, A.R., Rogers, T.B. & Smythe, P. Why are pictures easier to recall than words? Psychonomic Science. 1968, 11, 137 - 138.

Pearson, P.D. & Spiro, R. The new buzz word in reading is schema. Instructor, 1982, May, 46 - 48.

Pierce, J.W. Field independence and imagery-assisted prose recall of children. Journal of Educational Psychology. 1980, 2, 200 - 203.

Pressley, M. Elaboration and memory development. Child Development. 1982, 53, 296 - 309.

Rasinski, T. Cognitive style and reading. Implications from field dependence research for reading instruction. Paper presented at the Fifth Great Lakes Regional Conference of the International Reading Association. 1983. (ERIC Document Number ED 241 899).

Resnick L.B. Toward a cognitive theory of instruction. In Paris, S.G., Olsen, G.M. & Stevensen, H.W. (Ed.) Learning and motivation in the classroom. Erlbaum Assoc. Hillsdale. New Jersey. 1983.

Rigney, J.W. Learning strategies: A theoretical perspective. In H.F. O'Neil (Ed.) Learning Strategies. New York: Academic Press. 1978.

Robins, C., & Shepard, R. N. Spatio-temoral probing of apparent rotational movement. Perception and Psychophysics. 1977, 22, 12 - 18.

Roethlisberger, F.J., & Dickson, W.J. Management and the Worker. Cambridge, Massachusetts: Harvard University Press., 1939.

Rorschach, H. Psychodiagnostics. Verlag Hans Huber, Berne, Switzerland. 1942.

Rowher, W.D. Jr. Images and pictures in children's learning. Psychological Bulletin. 1970. 73, 393 - 403.

Rowher, W.D. Jr. Elaboration and learning in childhood and adolescence. In Reese, H.W. (Ed.) Advances in Child Develoment and Behavior. Vol. 8. New York: Academic Press, 1973.

Rowher, W.D. Jr., & Ammon, M.S. Elaboration training and paired - associate learning efficiency in children. Journal of Educational Psychology, 1971, 62, 376 - 383.

Rumelhart. 1979. Advances in Discourse Processing. In Freedle, R.O. (Ed.) New Directions in Discourse Processing. Ablex Publishing Corp. New Jersey. 1979.

Rumelhart, D.E., & Norman, D.A. Accretion, tuning, and restructuring: Three modes of learning. In Cotton, J.W., & Klatsky, R.L. Semantic Factors in Cognition. Erlbaum, New York. 1978

Rumelhart, D.E., & Ortony, A. The representation of knowledge in memory. In Anderson, R.C., Spiro, R.J. & Montague, W.E. (Ed.) Schooling and the Acquisition of Knowledge. Hillsdale, New Jersey. Lawrence Erlbaum Associates. 1977.

Selfridge, O.G., & Neisser, U. Pattern recognition by machine. Scientific American, 1960, 203, 60 - 68.

Schank, R. & Abelson, R. Scripts, Plans, Goals, and Understanding. Hillsdale, New Jersey.: Lawrence Erlbaum Associates. 1977.

Shepard, R.N. Recognition memory for words, sentences, and pictures. Journal of Verbal Learning and Verbal Behavior. 1967, 6, 156 - 163.

Shepard, R.N. The mental image. American Psychologist. 1978, February, 125 - 137.

Shepard, R.N. & Chang, J.-I. Forced choice ntests of recognition memory under steady-state conditions. Journal of Verbal Learning and Verbal Behavoir. 1963, 2, 93 - 101.

Shuell T.J. Learning theory, instructional theory, and adaptation. In R.E.Snow, P.A.Federico, & W.E.Montague (Eds.), Aptitude learning and instruction. Hillsdale, N.J.: Erlbaum, 1980.

Shuell T.J., & Lee, C.Z. Learning and Instruction. Monterey, Californina: Brooks/Cole. 1976.

Spiro, R.D., & Tirre, W.C. Individual differences in schema utilization during discourse processing. Journal of Educational Psychology, 1980, 72, 2, 204 - 208.

Standing, L., Conezio, J., & Haber, R.N. Perception and memory for pictures: Single-trial learning of 2500 visual stimuli. Psychonomic Science, 1970, 19, (2), 73 - 74.

Stroop, J.R. Studies in interference in serial verbal reactions. Journal of Experimental Psychology, 1935, 18, 632 - 662.

Stuart, I.R. Perceptual style and reading ability: Implications for an instructional approach. Perceptual and Motor Skills, 1967, 24, 135 - 138.

Sutherland, N.S. Outlines of a theory of visual pattern recognition in animals and man. Proceedings of the Royal Society. Series B, 1968, 171, 297 - 317.

Treisman, A. Monitoring and storage of irrelevant messages in selective attention. Journal of Verbal Learning and Verbal Behavior, 1964, 3, 449-459.

Watson, J.B. Psychology as the behavorist views it. Psychological Review, 1913, 20, 158 - 177.

Watson, J.D. The Double Helix. New York: The New York American Library, 1968.

Weinstein, C. Elaboration skills as a learning strategy. In O'Neil, H.F. Jr.,(Ed). Learning Strategies. Academic Press. New York, 1978.

Williams, F., & Naremore, R.C. On the functional analysis of social class differences in modes of speech. Speech Monographs, 1969, 36, 77 - 102.

Wineman, J.H. Cognitive style and reading ability. California Journal of Educational Research, 1971, 22, 74 - 79..

Witkin, H.A. Individual differences in ease of perception of embedded figures. Journal of Personality. 1950. 19, 1 - 15.

Witkin, H.A., Dyck, R.B., Faterson, H.F., Goodenough, D.R., & Karp, S.A. Psychological differentiation. New York: Wiley & Sons, 1962.

Witkin, H.A., & Goodenough, D.R. Cognitive Styles : Essence and Origins. International Universities Press, Inc. New York. 1981.

Witkin, H. A., Moore, C. A., Goodenough, D. R., & Cox, P. W. Field-dependent and field-independent cognitve

styles and their educational implications. Review of Educational Research, 1977, 47, 1-64.

Witkin, H.A., Oltman, P.K., Paskin, E., & Karp, S.A. A Manual for the Embedded Figures Test. Palo Alto, Calif. Consulting Psychologists Press, 1971.

Witrock, M.C. The cognitve movement in instruction. AERA Annual Meeting. Division C State-of-the-Art Address. 1978.

Winn, W. Visualization in learning and instruction: A cognitive approach. Educational Communication and Technology Journal. 1982. 30, 1, 3 - 25.

Wood, G. Mnemonic systems in recall. Journal of Educational Psychology. 1967, 58, 6, 1- 27, Part 2.

Wundt, W. An Introduction to Psychology. R. Pinter, London: G. Allen and Company, 1912.

Yates, F.A. The Art of Memory. London, Routledge and Kegan Paul. 1966.

Zajano, M.J., Hoycenyk, E.M., & Ouellette, J.F. A confound in the standard control conditions of the Stroop experiment. Perceptual and Motor Skills, 1981, 53, 835 - 841.

APPENDIX A

Consent of Parent or Guardian for Student to Participate in Research Project.

CONSENT OF PARENT OR GUARDIAN

FOR

STUDENT TO PARTICIPATE IN RESEARCH PROJECT

Dear Parents,

Students today are required to remember many different kinds of materials. I am planning to test the effectiveness of a learning strategy that can be used by students to help them remember visual images.

Your son/daughters' teacher has expressed interest in the project and I would like your permission for your son/daughter to take part. I will need to administer three short tests to the students. These will help to identify the way in which they perceive visual information and how effective a particular learning strategy is for them.

Each child will be worked with individually, and the time required should be no longer than one Language Arts' period, approximately one hour. Though the final results of the study will be available to the school and to you, at no time will the students be required to put their name on any of the papers, and there will be no way of tracing individual results. After the data have been analyzed individual result sheets will be destroyed.

Yours truly,
Janice K. Irvine,
Graduate Student,
University of Calgary.

This is to certify that I give my permission for my child, _____, to take part in the Learning Strategies Study to be conducted by Mrs. J. Irvine.

Signature_____
Date_____

Teacher_____
School_____

APPENDIX B

Transcript of Treatments

TRANSCRIPT OF TREATMENT

Introduction to Students

My name is Mrs. Irvine and I am from the University of Calgary. I am very interested in how different types of people remember information, and so I am investigating some particular learning strategies.

Your class will be divided into three groups, and I will work with you individually. I will use a couple of interesting "No - wrong - answer" tests to find out some things about you. Then I'll get you to view some slides. I'll see you again in one week's time.

Just as some people have individual tastes in ice -cream, so they also have individual ways of remembering things. I will appreciate all your efforts, and will send a copy of the results of the study to the school so that you may find out what the final results were.

Personal Data Collection

My name is Mrs. Irvine and I am going to be working with you for the next few minutes.

Please give me the date when you were born and how old you are. Thank you. We are going to start with one of the "No - Wrong - answer " tests. There will be two of them and most people find them interesting. They do not test how much you know, but rather, try to find out how you perceive the world around you. They are quite a change from the usual sort of school tests that you probably have to do. We will do an Embedded Figures Test first, then a color test. (Administer tests.)

Thank you very much. You may return to class.

Condition One Transcript (On tape)

Control Group

Subject's number will be transferred from the master sheet to the data record sheet, which will be on the back of the Children's Embedded Figures Test Score Sheet.

Tape will be turned on.

You can operate the slide projector with the remote control unit. If you need some help, please ask now. You will be timed, not to see how fast you can do this task, but just to see how long it takes someone such as yourself to do this task. Please take your time, and do not rush yourself.

Turn to the first practice slide. Remember what was said when the project was explained to you in class? People remember things in different ways. You are going to see this slide and another practice slide and then fifteen trial slides. Look at this slide and try to remember it. You can use any way of doing this that you like. If you would like to share the way that you are using to remember this and the rest of the slides, please feel free to tell me. I would like to write down what you say so that I can look at it later.

Turn to the second practice slide when you are ready.

Tape will be stopped at this point and will proceed when subject turns to the next slide.

You are now on the second practice slide. You are to remember this slide. You can use any way that you wish.

Subjects will proceed at their own rate, turning to the next slide as they are ready. Tape will continue with similar statement for each slide. Statement will retain the meaning as above.

Condition Two

Teacher Generated Associations Condition (On tape)

You are about to see some shapes on the slide viewer. Just as you need to remember different shapes such as road signs and the shapes of countries, I want you to remember these. I am also going to teach you a way of remembering them. You will control the slide viewer with the remote control button (researcher will give remote control to the subject, and will allow subject to handle it.) I will stop and start the tape recorder, so you don't have to worry about it at all. When you see a shape on a slide, I will tell you

something that looks like that shape. I want you to think of the thing that I have told you, and try very hard to see it in the shape that you see before you. There are fifteen shapes for you to see. You can take your time. Remember to look for the thing that I name, picture it in your mind's eye, and look for that thing in the slide. I will show you two slides and help you to practice with them. Then you are on your own, though I will be here with you.

Trial One.

Please turn to the first trial slide.

These two women with the fancy hair-dos are gossipping. Can you see the women?

(Researcher will point on the screen to outline the women if necessary.)

Make a picture of them in your minds eye. Can you see the women?

Researcher will continue when student replies that the association has been made. If the student still does not see the two women, the researcher will trace around the heads, pointing out the

noses, the mouth and so on. If the association is still not made, the second trial will proceed.

Trial Two.

> Two men are facing into the wind. Do you see their hair blowing back?

Researcher will proceed as for the first practice slide. If subjects say they cannot make the association without the researcher giving extensive assistance, then the subject will be thanked for assisting with the project and will be released back to class.

Tape continues.

> You will be timed, not to see how fast you can do the task, but just to see how long it takes someone to do this task. Please take your time and do not rush yourself. When you are ready, you may turn to slide one.

Researcher will reactivate tape, pausing between slides, proceeding when the subject proceeds to the next slide.

Slide One.

> A star is in the dark clouds. Look for the star in the dark clouds.

Slide Two.

The ugly heads are back to back. See the heads.

Slide Three.

See the moose head facing you.

Slide Four.

An old Indian arrowhead is pointing upwards. See the arrowhead.

Slide Five.

Here are two of the three bears. See the two bears.

Slide Six.

An old boot is on a mirror. See the boot.

Slide Seven.

Two goblins are holding a ball between their foreheads. See the ball.

Slide Eight.

Six islands are in the ocean. See the islands.

Slide Nine.

This moose has a hat on. See the moose.

Slide Ten.

This boot has a spur on it. See the spur on the boot.

Slide Eleven.

This bear is wearing a crown above the hole in his forehead.

Slide Twelve.

The twins are staring into each others' eyes. They are really staring.

Slide Thirteen.

The rocket is taking off into the sky. See the rocket.

Slide Fourteen.

The white Star Wars spaceship can be seen against a dark sky.

Slide Fifteen.

The bear has a party hat on. See the bear.

The researcher will thank the subject for assisting with the study and request that they return to class.

Condition Three (On tape)

Student Generated Associations

Researcher will activate tape when personal data as described in Teacher Generated Associations section above has been transferred to the data sheet and subject is settled in front of screen.

I will show you how to operate the remote control for the slide projector. (Demonstrate.) Please turn to slide one.

This is a trial slide. Please look at it carefully, because I want you to be able to remember it. One way to remember it is to associate the shape with something that you already know. In this slide you could see the shape of two women with fancy hairdos. Do you see them? Do you see something else? Can you tell me what you see? Can you trace around the picture and tell me?

Pause.

When you think you can remember the shape using the association that you have generated, you may turn to the next practice slide. Look at the second practice slide. Look for something that you recognise in the shape. Then make a picture of that thing in your mind's eye, and put it on the shape that

you see here. If you think it would assist you, please tell the researcher what you see. I will be making a tape of it.

Pause.

You will be timed, not to see how fast you do the task, but just to see how long it takes someone to do this. Please take your time and do not rush yourself. You may tell me what you see. When you are ready, you may turn to the trial slides.

Slide One.

Look for something that you know in this slide. If you think it will help you to remember it you may tell me the association that you have generated.

The explanation for slide one will be repeated with minor changes for each of the fifteen slides.

Thank you for your assistance.

Subject will then be asked to return to class.

Test (On tape)

A comment such as the following will serve as an introduction and hopefully will establish some rapport with the subject so that testing may begin.

> Remember me? I'm Mrs. Irvine and I was here last week with some slides and a tape recorder. I have some slides again today, and I also have the tape recorders. You get to operate the slide projector again, and I have the tape recorders to deal with. Do you remember how to operate the slide projector?

If the subject replies in the negative, the researcher will demonstrate the forward button on the remote control and will work with the subject until it can be operated with ease.

The researcher will turn on the tape recorder to tape any subject responses, will give the subject number so that comments can be matched to results at a later time, and will also turn on the post-test tape. Transcript follows.

> Hi there. Last week we looked at some slides and you were asked to remember them in a certain way. I said that different people remember information in different ways, just as people have different tastes in ice cream.

Think hard to remember the way that you were asked to remember them. If you remember this, please tell me. (Pause). Tell me if you have seen the shape on the screen before today. If there is something about the shape that helps you to remember it then please say so. I'll tape your answers because I'll be very interested in them. You have plenty of time. You can operate the remote control button, so that you need not feel that you have to rush. Whenever you are ready, you may begin.

Slide One:

Look hard at the slide. Have you seen it before? (Subject responds.) How do you know? (Subject responds.)

Researcher will operate the tape recorder which will repeat this with only the slide number changing until all twenty test slides have been viewed.

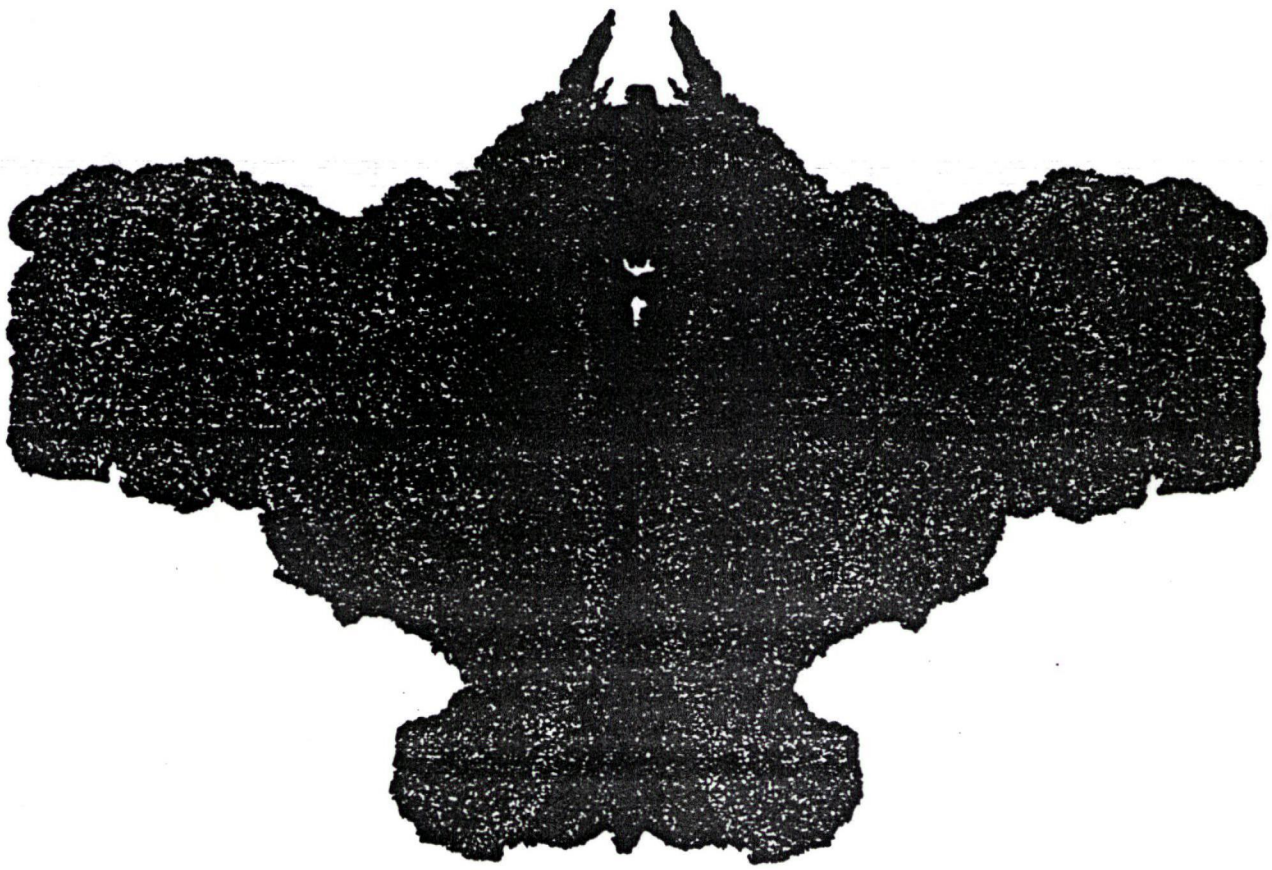
Thank you for your assistance. You may return to class now.

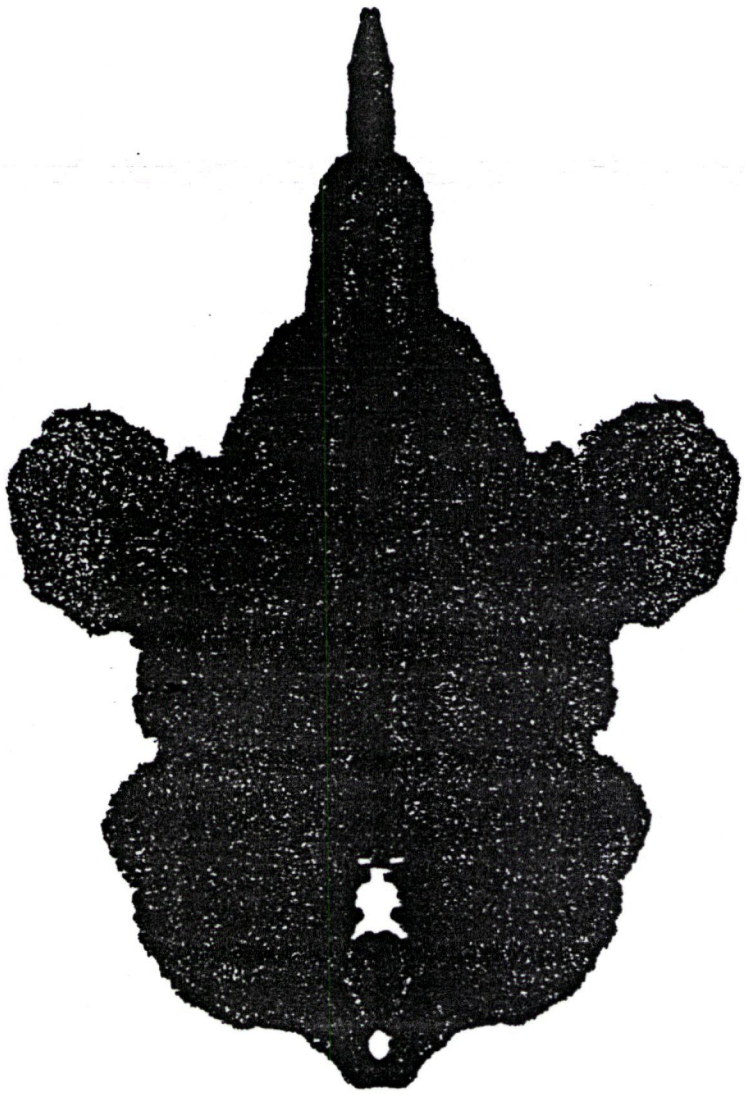
APPENDIX C

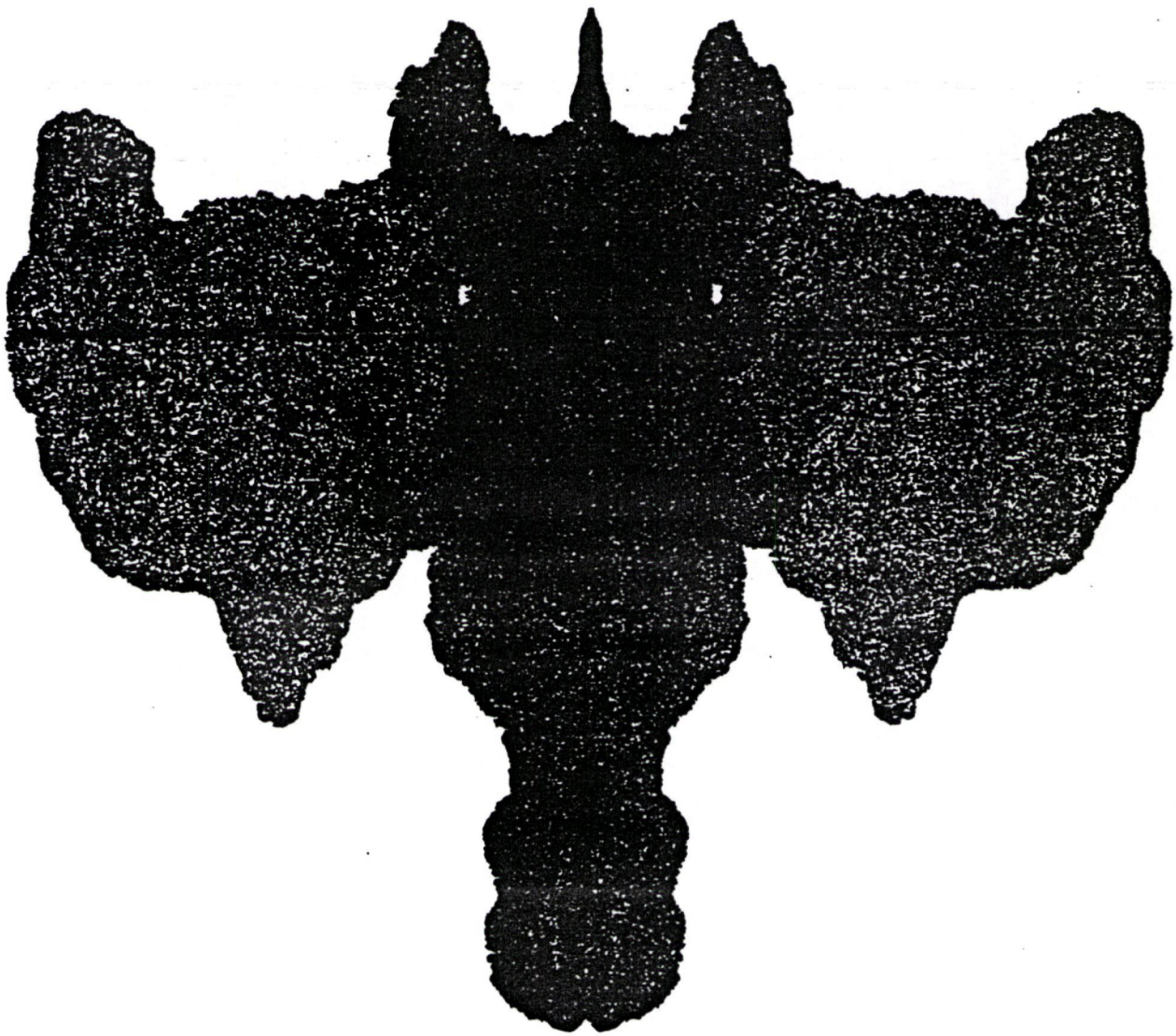
Examples of Stimulus Materials

STIMULUS MATERIAL

The following are some examples of the inkblots that were put onto slides for use in the treatment. The original inkblots were photographed using a copy stand and 100 ASA slide film to bring the shapes to approximately the same size and ink density.







APPENDIX D

Data Collection

Individual Data Collection.

Code. Stroop. Times. Score:

Condition. (1. 2. 3.)	Test.
Date.	Date.
Practice 1.	Time.
Practice 2.	1.
Time.	2.
1.	3.
2.	4.
3.	5.
4.	6.
5.	7.
6.	8.
7.	9.
8.	10.
9.	11.
10.	12.
11.	13.
12.	14.
13.	15.
14.	16.
15.	17.
	18.
	19.
	20.

APPENDIX E

Ethics Committee Consent for Project

THE UNIVERSITY OF CALGARY

2500 University Drive N.W., Calgary, Alberta, Canada T2N 1N4

FACULTY OF EDUCATION
Department of Educational Psychology

Telephone (403) 220-5651

1986-03-21

Ms. Janice Irvine
Curriculum and Instruction
Faculty of Education
University of Calgary

Dear Ms. Irvine,

The Education Joint Research Ethics Committee has approved* your proposal, entitled "The Effectiveness of the Origins of Analogy Upon Student Learning of Visual Images by Students Exhibiting Different Cognitive Style".

You should now contact Dr. Janelle Holmes, Supervisor, Program Evaluation, Education Centre, 515 Macleod Trail SE, Calgary T2G 2L9 (294-8175) to seek approval for the implementation of your study in the school system.

I am enclosing three copies of an agreement form for research outcomes that you should complete with Dr. Holmes, returning one copy of the signed agreement form to this office.

Yours sincerely,

Anita K.F. Li, Chair
Education Joint Research Ethics Committee

c: Dr. J. Holmes

*Conditions (if any) are attached
Enc.

APPENDIX F

Raw Data from Protocols

Code	Group	Sex	CEFT	Stroop	Age	Score	Match	Condtime	Testtime
171	1	'F'	17	24	145	95	40	216	232
168	1	'M'	18	76	145	75	40	183	95
166	1	'F'	14	58	152	55	0	246	230
165	1	'F'	11	24	141	95	60	507	223
164	1	'F'	18	32	137	100	80	0	171
160	1	'M'	14	31	153	85	60	360	275
153	1	'M'	23	37	143	85	50	240	255
147	1	'F'	24	26	136	80	10	336	147
144	1	'F'	22	34	144	55	20	165	142
141	1	'F'	4	55	143	80	50	246	126
140	1	'M'	10	44	135	80	60	173	205
138	1	'F'	11	66	138	90	60	204	182
137	1	'F'	10	34	145	80	100	143	110
135	1	'F'	22	36	143	90	40	193	154
132	1	'M'	18	41	155	80	0	164	277
123	1	'M'	12	31	150	85	70	581	0
118	1	'M'	16	23	137	95	0	210	136
116	1	'F'	12	12	141	90	40	207	207
105	1	'M'	18	10	135	90	70	241	173
134	2	'F'	13	26	134	85	60	0	217
131	2	'F'	10	27	142	90	60	211	162
130	2	'F'	16	43	143	75	10	228	298
129	2	'F'	13	27	136	90	70	209	172
128	2	'M'	14	41	143	65	60	242	191
126	2	'M'	20	51	141	90	50	264	227
125	2	'M'	23	44	143	85	70	257	167
115	2	'F'	18	34	142	85	70	176	147
114	2	'M'	17	23	142	85	60	261	121
113	2	'F'	12	26	135	95	40	266	234
111	2	'M'	13	78	139	80	40	254	211
106	2	'F'	16	53	143	85	80	278	187
104	2	'F'	20	41	141	75	40	183	184
101	2	'F'	13	21	147	80	40	238	158
170	2	'M'	10	59	140	85	80	228	214
162	2	'M'	22	47	139	75	60	271	193
159	2	'M'	16	24	144	70	55	252	223
155	2	'F'	15	42	139	75	30	195	214
148	2	'F'	16	34	139	85	40	216	193
161	3	'F'	17	45	151	90	70	640	142
158	3	'F'	16	40	136	75	30	367	164

Code	Group	Sex	CEFT	Stroop	Age	Score	Match	Condtime	Testtime
154	3	'M'	11	48	140	90	80	575	423
151	3	'F'	12	40	140	95	90	395	191
150	3	'M'	7	34	150	75	30	243	345
149	3	'M'	12	41	136	85	50	349	153
146	3	'F'	19	35	144	80	30	420	436
145	3	'M'	9	58	154	85	20	649	177
142	3	'M'	15	25	143	80	40	602	0
139	3	'M'	11	45	135	85	70	0	306
127	3	'M'	11	78	142	85	50	0	119
122	3	'F'	17	59	144	65	60	181	124
121	3	'F'	20	30	149	90	80	343	146
117	3	'F'	12	33	144	85	60	239	125
112	3	'F'	18	22	140	60	30	0	189
107	3	'F'	24	29	140	90	70	244	126
103	3	'M'	14	59	141	75	60	0	134
102	3	'F'	13	42	140	75	60	320	150

APPENDIX G

Means and Standard Deviations by Group.

Group	One		Two		Three	
Variable	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Age	143.05	6.09	140.63	3.23	142.72	5.33
CEFT	15.47	5.28	15.63	3.71	14.33	4.28
Stroop	36.52	17.18	39.00	14.65	42.38	14.11
Match	53.12	22.12	53.42	17.95	54.44	20.64
ConTime	256.38	119.07	234.94	30.97	397.64	158.74
TestTime	185.55	55.42	195.42	38.84	202.94	105.57
Score	83.42	12.02	81.84	7.67	81.38	9.20