EFFECTS OF IMPOSED VISUALS AND INSTRUCTIONS TO IMAGE ON IMMEDIATE RECALL IN STUDENTS OF VARYING AGES AND COGNITIVE STYLES

by

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The purpose of this research was to determine if level of field dependence affects a student's ability to profit from either imposed visuals or instructions to form visual images to aid immediate recall of concrete paired-associate nouns. Also of interest are possible changes in the relationship between field dependence and visual strategy as students move from upper elementary to high school. It was hypothesized that the field-dependent individual is less able to profit from the use of interactive imagery required in a memory task of this nature due to the inability to impose structure in a non-structured situation.

Participants in this study were 197 fourth, seventh and tenth grade students from a moderately affluent, suburban community in southwestern Virginia. The Group Embedded Figures Test was used to determine cognitive style. Within each grade level, an equal number of students classified as field dependent, neutral and field independent were randomly assigned to three treatment groups. The dependent measure of memory was a written test of immediate recall of 24 paired-associate, concrete nouns. The three treatment groups were: Control, who
received only instructions to remember the words; Imposed Visual, who viewed line drawings of the two words; and Imagery, who received instructions to form interactive visual images of the two words.

Data was analyzed using three-way Analysis of Variance. All three main effects (grade level, cognitive style and visual strategy) were significant. There was no interaction, however.
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Chapter 1
INTRODUCTION

Visual imagery has been documented as a successful mnemonic to enhance memory since the time of the early Greeks. Cicero, suggested its use in De Oratore, about 500 B.C.:

Persons desiring to train this faculty (of memory) must select places and form mental images of the things they wish to remember and store these images in the places, so that the order of the places will preserve the order of the things, and the images of the things will denote themselves. (Yates, 1966, p. 2)

Interest in imagery has continued with the topic receiving considerable research beginning in the late 1800's and continuing until behaviorism became the dominant area of focus (Higbee, 1979). In the last twenty years there has been a resurgence of empirical research, much of which has focused on understanding how visual information is represented in memory. Paivio's (1971, 1986) dual coding theory underlies many of the current studies. It is a widely held tenet that pictures almost always increase learning and memory when compared to verbal communications alone (Fleming, 1979; Levin & Lesgold, 1978; Paivio, 1986; Pressley, 1977). There is evidence that pictures supplied to the learner and use of visual imagery as a
mnemonic strategy may serve similar purposes for information processing (Finke, 1980). Hanley (1988) suggests that imagery may serve as an acceptable substitute for perceptions. This is based on evidence presented by Shepard and Cooper (1982), Finke (1980), Kosslyn (1981) and Paivio (1979) supporting the position that “visual images have many of the same sensory, spatial, and semantic qualities of visual perceptions” (Hanley, 1988, p. 91).

In the field of instructional technology, researchers continue to explore specific individual learner attributes that may contribute to the efficacy of visuals in learning. Emphasis has shifted away from the use of a specific medium or teaching strategy toward studying differences in how individuals perceive and process information within the medium or method. Clark (1983) and Salomon (Clark & Salomon, 1986) encourage researchers to consider areas of learning theory including teaching behaviors, learner aptitudes and instructional objectives as variables for instructional technology research. Focus has turned to differences in information processing relative to the visual, the task and the learner.

Recently, many studies on learning have focused on the popular issue of learning styles, one aspect of which is founded in the broad constructs of psychological differentiation theory (Witkin & Goodenough, 1981). Roots for these lines of investigation lie in the “new look” movement of forty years ago which identified several cognitive styles for research and study. Of those styles, field-dependence-independence has received the most attention (Linn & Kyllonen, 1981; Witkin, 1981). This research will focus on comparing the effectiveness of
imposed visuals and instructions to form visual images for students at varying developmental levels who tend to be either field dependent or field independent.

Need for the Study

More than 2,000 studies have been conducted considering a variety of treatment effects within the field-dependence-independence construct (Witkin, 1981). The use of imagery as a memory aid has also been studied in tandem with a variety of learner traits. There has been very little research connecting the two, however, and two recent studies produced somewhat conflicting results. For sixth-grade children, Carrier, Joseph, Krey & LaCroix (1983) found imagery to be superior to supplied visuals for all learners and field independent students to exhibit superior recall regardless of treatment. Joseph (1987) found that for adult graduate and undergraduate students ranging in age from 20 to 54 years, those classified as field independent scored higher in an imposed visual situation than with imagery. In contrast, field-dependent subjects scored higher in the imagery situation. Although these studies did not use identical methods, the apparent differences in the relationship of cognitive style to ability to profit from imagery instructions across age groups pose interesting questions for further research.

During the last decade interest in learning styles research has swelled. Of the “styles” defined to date, the field-dependence-independence aspect of cognitive style seems most relevant to the field of instructional technology. A better
understanding of individual differences in visual perception and resulting information processing may help explain why students learn from specifically designed instructional materials. By the same token, understanding similarities and differences in effectiveness of visuals versus student-generated imagery could lead toward enhanced use of imagery instruction as a teaching strategy to foster organization and retrieval of information for some, if not all, students. In addition, inherent relationships among cognitive style, use of visual material and use of imagery will offer greater possibilities for combining the use of imagery and visuals as a teaching strategy.

This research will attempt to determine if level of field dependence affects the ability to profit from either imposed visuals or instructions to form visual images to aid immediate recall of concrete paired-associate nouns in relation to the following: (1) relationships which may exist between cognitive style and utilization of a particular visual strategy; and (2) possible changes in the relationship between field dependence and visual strategy as students move from upper elementary to high school.
Definition of Terms

The following terms are defined as they are used in this study:

cognitive style - “characteristic ways of organizing and processing information and experience” (Messick, 1976); in this study, cognitive style will refer to the field-dependence-independence construct

field dependence - a cognitive style in which the individual relies on external referents for perception (Witkin, 1981); for this study, global and less able to disembed and restructure information

field independence - a cognitive style in which the individual tends to be autonomous, relying on self for perceptual referents (Witkin, 1981); for this study, articulated or analytical and more able to disembed and restructure information

imposed visual - picture supplied to the learner

visual image - nonverbal mental representation; for this study will be self-generated

developmental - changing over time or with advancing age/experience.
Justification for the Study

Supporting this study, empirical and theoretical literature was reviewed on the following topics: the effects of visuals and visual imagery on encoding and recall of verbal information; the use of imagery instructions and the development of imagery ability in children; and cognitive style.

Effects of Visuals and Visual Imagery on Encoding of Verbal Information

This study seeks to consider theories regarding the relationship of visuals to the retention of verbal information and applicable research that has been conducted in this area of educational psychology. Paivio's (1971, 1986) dual coding theory forms the basis for most of the recent research on this topic. The dual coding theory assumes that visual and verbal information are encoded in two independent but related memory systems with the distinct possibility that processing occurs in different hemispheres of the brain. Neuropsychological evidence (Gardner, 1987; Kosslyn, 1987; Paivio, 1986; Winn, 1980) of this is indicated by experiments on patients whose hemispheres have been surgically separated. Paivio (1986) provides an overview of empirical studies indicating hemispheric specialization as further evidence supporting the dual coding theory. Sperry (1966) cites studies of patients with surgically separated hemispheres in support of autonomous verbal and non-verbal systems. He concludes that each of the hemispheres “must sense, perceive, learn, and remember quite independently of the other hemisphere”
Sperry describes empirical evidence that has been obtained by blindfolding the subject and handing him an object in one hand. When the object is in the subject's left hand, he is unable to name it, but can manipulate the object in an appropriate manner. Winn (1980) recounts a similar finding:

For example, if such a patient is given a pair of scissors in the left hand (controlled by the right hemisphere), the patient can make cutting movements and can select a picture of a pair of scissors but is incapable of naming what is held in the left hand. If the scissors are placed in the right hand (controlled by the left hemisphere), they can be named verbally but cannot be used for cutting. (p. 123)

Paivio assumes that the greatest possibility of dual coding exists for pictures, then for concrete words and, finally, the lowest for abstract words. This is due to the presumption that pictures are likely to be semantically encoded verbally as well as "visually" and concrete words are very easily imagined or visualized as a concurrent activity to encoding the verbal label. Abstract words, on the other hand, may not be easily pictured and, therefore, may be coded only verbally.

Investigators have consistently found visual stimuli or a combination of visual/verbal stimuli to produce superior recall and recognition when compared to verbal information alone. Shepard (1967) found recognition memory for pictures superior to that for either words or sentences. Subjects were presented with 600 pictures and were able to identify with 98% accuracy the pictures they had seen when presented with pairs containing one original and one new, but similar, illustration. Standing, Conezio, and Haber (1970) found that recognition memory
for pictures on an immediate retention test averaged better than 90% even when subjects viewed 2560 pictures.

There is strong evidence that meaningful, relevant visual representations do enhance retention of verbal material. Burton (1982) compared recall for pictures, printed words and spoken words with all data showing superior recall for pictures. Third-grade children in this study were also asked to recall the presentation type and were usually able to do so correctly for correct responses. This knowledge of the specific communications medium seems to support the assumption that "a picture of a star is stored as an image of a star, and as a 'picture of a star' in the verbal system" (Burton, 1982, p. 166).

Levin, Shreberg, and Berry (1983) considered pictures as an aid to remembering prose containing abstract and unrelated conceptual information and found that pictures of an interactive nature were necessary. Individual pictures lacking this interaction were not effective for enhancing either amount remembered or organization. This "interactivity" is supported by Rohwers' theory of form class effect which states that when pairs are accompanied by a connector, retention is related to the semantic elaboration of a relationship. Prepositions and verbs were shown to be more effective connectors than conjunctions because, generally, a relationship is implied (Yuille & Marschark, 1984). It follows that encoding of visual information depicting interaction would have this same connective effect.
The importance of interactivity in a paired-associate task involving imagery was demonstrated by Bower (1970). Using the same list of words, participants were asked to either imagine the two in an interactive situation or imagine the two separately. The recall test indicated much better performance under the interactive condition. A similar effect had been demonstrated earlier with pictures that were either interactive or separate (Paivio, 1980).

**Instructions to Image and the Development of Imagery Ability in Children**

In an overview of this subject, Richardson (1980) concluded that, “experimental research on the value of instructions to use mental imagery in learning verbal material has generally demonstrated consistent, reliable and substantial improvements in performance” (p. 71). He suggests that this may be due to both the dual coding of visual information and the process of visualization itself. “The elaboration of verbal material by the construction of mental images is known to affect long-term or secondary memory” (Richardson, 1980, p. 71). Positive effects of imagery can be further explained by the coding redundancy hypothesis (based on the work of Bower and Paivio), which states that “memory performance varies with the number of alternative codes available for an item” (Richardson, 1980, p. 73). Paivio (1971) observed the same effect:

Any superiority observed under imagery mnemonic conditions may result from the addition of imagery to a verbal baseline laid down during the subject’s initial representational or associative reactions to
the to-be-learned items, i.e., two mediational systems are potentially available rather than one. (p. 389)

Numerous studies have been conducted with adult subjects. Jamieson & Schimph (1980) reported that self-generated images produced better recall on paired-associate tasks than images specified by the examiner. They concluded that "internal and external image generation would differentially support memory to the extent that processes of image formation were differentially memorable" (p. 31).

Geisen and Peeck (1984) found that college students who were instructed to form mental images while reading a 2300-word story by Gorki showed better performance in three of four areas: recall of explicit concrete information, contradictions in text and spatial relationships. There was no difference on questions requiring recall of abstract-explicit information. This supports Paivio's theory that imagery effectiveness is greatest for concrete information.

Hunter tested high and low imagers, according to Betts' Questionnaire Upon Mental Imagery, to determine if vivid imagers could perform as well with verbal stimuli as with pictorial. She concluded (Hunter, Moore & Wildman, 1983):

Neither imagery ability, as measured by the Betts' test of mental imagery, nor the presentation mode -- words and pictures versus words only -- resulted in differential ability to recall paired associates for both the immediate and delayed tests, However, paired associates generated from concrete words resulted in significantly greater recall than did the abstract material, and these
efforts held across both imagery ability levels and both presentation modes. (p. 180)

Recent studies have considered visual imagery as a learning device for children. Sears and Johnson (1986) found visual imagery to be superior to verbal pronunciation of words for both spelling performance and retention “particularly when coupled with appropriate imagery suggestions that serve as visual memory locations for the visual code” (p. 230). They concluded that “maybe a mental picture is also worth a thousand pronunciations” (p. 233).

Forisha (1975) conducted a study of the development of mental imagery ability compared to verbal processes by administering a battery of nine tests to 200 students in grades one through five. She concluded that verbal processes and mental imagery develop in a curvilinear manner with parallel rates of change and that cognitive and subjective components of imagery are distinct from each other and from verbal abilities. Her findings support those of Piaget and Paivio that verbal and imaginal processes are independent traits whose development parallels each other rather than the imaginal preceding the verbal as stated by Bruner (Forisha, 1975).

Other studies of imagery in children suggest that the ability to mediate may not develop until between eight and ten years of age (Yuille & Marschark, 1984). Pressley and Levin (1980) used first and sixth graders to study the effects of instructions to image and the necessity for retrieval clues (reminders to students
during testing to make use of the images they created). They found that reminding students to use the images they had generated was essential for first graders but not for sixth graders.

Cramer (1981) found that interactive imagery instructions facilitated performance for fifth but not first graders and hypothesized that this was due, at least in part, to the inability of many of the younger children to understand the interactive instruction. She drew this conclusion from questioning the children about the methods they used to remember.

Alesandrini (1982) suggests that meaningful learning of prose material can be facilitated proportionately by pictures, concrete verbal stimuli and imagery instructions with each supplying less support to the learner. From this model comes the conclusion that young children who are not able to image may be supported by the provision of pictures to generate cues for imagery. Guttman, Levin & Pressley (1977) produced similar results that suggest partial pictures can be used to prompt imagery in children as young as six. They found that imagery was an effective memory aid under this condition.

In summary, research has shown that "imposed mediators, whether verbal elaborations or pictorial interactions, enhance memory, with the effectiveness of both types increasing with age" (Yuille & Marschark, 1984, p. 4). The most important element of imagery instructions used to facilitate recall appears to be
interaction which, according to Bower, may produce a cohesive effect increasing organization (Richardson, 1980).

Self-generated images have been shown to serve important organizational functions for children. According to Pressley, "organization has also been found to be important in children's free recall and imagery has been implicated as one mode of organization" (Yuille & Marschark, 1984, p. 9). Levin (1981) suggests that for students who have adequate word-recognition skills but still fail to comprehend, "generating images of prose content may be just the organizational strategy they need to foster comprehension" (p. 210).

Instructions to formulate a visual image may serve several distinct functions in the learning process. The image itself may serve the same purpose as a picture or prepared visual: that of increasing possibilities for retrieval from memory due to dual coding. It would follow, then, that the image should be interactive to be effective as was found with pictures (Levin, 1983). Another function relating to memory retrieval is the semantic process involved in formulating the image. Both product and process may be important to retention. Finally, the organizational nature of the image may serve as a facilitator to group knowledge in cognitive structure in a meaningful way, thereby enhancing possibilities of recall.
The Field Dependence-Independence Cognitive Style

The concepts of field dependence-independence and psychological differentiation emerged from studies of perception of the upright beginning in 1948 (Witkin & Goodenough, 1981). An individual’s placement on the field dependence-independence continuum evolves from his frame of reference in relating surroundings to self. Those who tend to be field dependent rely heavily on the surrounding field for perceptual cues while the more field-independent individuals rely on internal cues. Witkin (1981) has termed the extremes of the bipolar continuum as articulated (independent) and global (dependent). Analytical is used by some authors and researchers rather than articulated. Early investigations by Witkin and his associates (Witkin & Goodenough, 1981; Witkin, et al., 1977) involved tests designed to indicate ability to determine the upright. In the Rod and Frame Test (RFT) a lighted frame which can be rotated is presented in a darkened room, along with a rod which can be tilted independently of the frame. The participant must adjust the rod to a position he perceives as upright. The field-independent individual is more adept at this task than one who tends to be field dependent. For the Body Adjustment Test (BAT), the individual sits in a chair in a small room, both of which can be tilted in either the same or opposite directions. With the room tilted, the participant must direct alignment of the chair to a position perceived as upright. Again, field-independent individuals are better able to assess the true vertical position.
Closely related to perception of the upright is the ability to distinguish individual parts from the surrounding field. Field independents are able to separate individual parts and thus disembed an object from its surrounding field, while the field dependent views the field globally and is often unable to separate parts from the whole (Witkin & Goodenough, 1981; Witkin, et al., 1977). This disembedding function forms the theoretical basis for the Embedded Figures Test and the Group Embedded Figures Test (Witkin, Oltman, Raskin, & Karp, 1971) which classify individuals based on ability to locate simple geometric figures embedded in more complex figures. The individual who tends to be more field independent is one who is able to perceive the upright, separate parts from the whole, and impose structure on unstructured information. This cognitive restructuring ability is derived from the use of internal as opposed to external referents. The more field-dependent individual, using external referents, perceives a given field holistically.

Witkin, et al. (1977) report self-consistency among the RFT, BAT and EFT with the common factor being "the extent to which the person perceives part of a field as discrete from the surrounding field as a whole, rather than embedded in the field; or the extent to which the organization of the prevailing field determines perception of its components" (p. 6). Caution must be exercised in the use of the tests interchangeably, however. Although the processes involved in perception of the upright and cognitive restructuring are closely related, they may be distinct from one another (Linn & Kylloinen, 1981).
Witkin & Goodenough (1981) contend that field dependents and field independents do not appear to differ in initial perception of most stimuli, but "field-independent people seem better able to achieve a different percept -- when required to do so by situational demands or inner needs -- through the restructuring of their initial perceptual experience" (p. 23). Differentiation theory (Witkin & Goodenough, 1981) postulates self-consistency, indicating that the level of restructuring ability evidenced by the disembedding function would remain fairly constant across various modes of intellectual functioning. This may account for the generally lower levels for field dependents on verbal as well as visual tasks requiring restructuring.

Considerable research has been undertaken in an attempt to determine relationships between field dependence-independence and various aspects of learning and memory. Several investigators have explored the effect of field dependence-independence on the processing of visual information. Wise (1984) hypothesized that field independence would interact with type of visual. Using a simple line drawing and realistic photograph developed by Dwyer (1972) and tests on comprehension and drawing, he confirmed superiority of the line drawing. Field dependence-independence had no effect, however. In addition, criterion test correlations with the GEFT indicated a significant relationship only for the comprehension test, which did not relate to the disembedding function. He concluded that "if field independence plays an important role in learning from visuals, it is probably not a disembedding role" (Wise, 1984, p. 138).
Canelos & Taylor (1981) found that providing field dependents with an information processing strategy combining an imagery peg-mnemonic technique with a hierarchical retrieval memory technique improved learning behavior. Using Dwyer's heart visuals with undergraduate students, they compared effectiveness of varying levels of visual display complexity. A comparison of results for field independents, field dependents and field dependents with information processing strategy showed that addition of the strategy did enhance performance of field dependents on both a list-learning and a spatial task.

Joseph (1987), again using Dwyer's heart materials, compared results for field-dependent and field-independent adults on a battery of four tests and found overall significance only for the field-dependence main effect. He reported interesting, though not significant, trends derived from the group means, however:

As indicated by the total test score means, field-independent subjects benefited most from presented line drawings, and, moreover, scored markedly lower when required to engage in the observable visual imagery strategy. In contrast, field-dependent subjects scored higher when required to engage in the observable visual imagery rehearsal. This improvement was evidenced in each separate test, except for a slight superiority of the control group in the case of the comprehension test. (Joseph, 1987, p. 7)

Carrier, Joseph, Krey, & LaCroix (1983) studied the effects of supplied visuals and instructions to image on recall for field-dependent and field-independent
children. Their findings indicate superior recall for field-independent children compared to field-dependent and superior recall for the imagery condition compared to the supplied visuals, but no interaction. The superiority of imagery over visuals is contrary to findings by James (1988) of no significant difference in recall between prepared visuals and instructions to image for elementary-age children.

Although the field-dependence-independence construct does not correlate generally with overall intelligence, Witkin & Goodenough (1981) present much evidence that field independence does correlate with spatial-visualization ability which is one component of many intelligence tests. They also point out that “the field-dependence-independence construct is conceptually quite different from other constructs to which they bear a surface similarity” (Witkin & Goodenough, 1981, p. 48). These “distinctly different” cognitive style constructs are locus of control, extraversion-introversion and reflection-implusivity.

Kaley (1977) explored the possibility of predicting children's learning style, as indicated by the Modified Learning Style Inventory, from results of the Group Embedded Figures Test. Her findings suggest that although the GEFT is an appropriate instrument for assessing cognitive style in sixth-grade children, it could not be used to predict learning style in general. The field-dependent children did exhibit greater variance which was attributed to learning style, however (Kaley, 1977).
In summary, psychological differentiation theory and the related cognitive style construct of field dependence indicates that individuals differ in the way they process information. The field-independent individual is an active learner, analyzing existing organization, restructuring when necessary to provide his own organization. The field-dependent learner tends to be passive, accepting the structure of the field as it exists. This person takes a holistic approach to incoming information, tending to notice salient cues, not necessarily the most relevant.

Research has consistently shown superiority in learning and memory tasks when meaningful, relevant visuals (pictures) are used to supplement verbal material. In most cases the use of visual imagery has also produced results somewhat better than with no mediation. It is the purpose of this research, then, to further explore the relationship between cognitive style as evidenced by placement on the field-dependence-independence continuum and the effectiveness of prepared visuals versus instructions to form mental images. The age factor is of interest because previous results have indicated conflicting and confusing interactions, particularly between use of imagery by children and adults exhibiting varying levels of field dependence.

Psychological differentiation theory and related research generate the hypothesis that the field-independent learner would function at a higher level in the imagery mnemonic condition of this study than would the field dependent. This is due to the rapid restructuring that will be required to create a memorable, interactive relationship (structure) between the two nouns. In the imposed visual treatment,
the simple line drawings have been designed to indicate a definite organizational structure and the salient aspects are also relevant. Misleading field information has not been included. For these reasons, little difference would be expected due to cognitive style. In the control group, it is likely that, again, field independents (particularly the older students) will exhibit superior memory due to their tendency to impose structure in the absence of direction.

Based on the preceding review of literature and theory, a research methodology designed to answer the following questions will be presented in Chapter two:

1. Is there a difference in the effect of teaching strategy (instructions to image versus imposed visuals) on immediate recall for students differing in cognitive style (field dependent, neutral, field independent)?

2. Is there a developmental difference in the effect of teaching strategy (instructions to image versus imposed visuals) among age groups (fourth, seventh, and tenth graders)?

3. Is the effect of teaching strategy (instructions to image versus imposed visuals) for students of varying cognitive styles (field dependent, neutral, field independent) different at varying age levels (fourth, seventh, tenth grade)?
Chapter 2

RESEARCH METHODOLOGY

Introduction

This study was designed to explore the effects of imposed visuals (pictures) and instructions to form visual images on memory for verbal information among students of varying cognitive styles and ages. The Group Embedded Figures Test (Witkin, et al., 1971) was employed to determine cognitive style and the treatment involved presentation of paired-associate concrete nouns, followed by a written test of immediate recall. Student participants ranged in age from fourth grade (approximately 10 years) to tenth grade (approximately 16 years.)

Research Hypotheses

The following hypotheses were tested in response to the research questions presented in Chapter I:

H #1 There are differences in the effects of teaching strategy on students differing in cognitive style.

H #1A Field-independent students will perform better than field-dependent students under all conditions.
H #1B  Field-dependent students will perform better in the imposed visual situation, than in imagery or control.

H #1C  For field-independent students, there will be no difference in performance under the imposed visual and imagery conditions.

H #2  There are developmental differences among age groups.

H #2A  Older students will perform better than younger students regardless of treatment.

H #2B  Under the imagery condition, older students will achieve a significantly higher recall score (in comparison to control of the same age) than younger students.

H #2C  Performance in the imposed visual condition will not differ significantly across age levels.

H #3  Teaching strategy will interact with cognitive style to produce different effects at different age levels.

H #3A  Older field-dependent students will perform better in the imagery condition (in comparison to control) than will younger field-dependent students.
**H #3B** Younger field-independent students will perform better in the imagery condition (in comparison to the control group of the same age) than will older field-independent students (ceiling effect.)

**Research Design**

A 3 x 3 x 3 post test only design was employed. The independent variables were cognitive style (field dependent, neutral, field independent) as measured by the Group Embedded Figures Test (GEFT); grade level (fourth, seventh and tenth grade) and teaching strategy (printed words only [control], imposed visuals, and instructions to image.) The dependent variable was a written, immediate recall test of 24 concrete paired-associate nouns.

**Rationale for the Experimental Design**

Research involving the addition of visual material to supplement verbal information has shown that provision of relevant, non-distracting visuals that overlap the verbal content almost always increases learning. Dwyer's (1972) extensive research on complexity of visuals concludes that for many types of learning objectives, simple line drawings are preferred. Therefore, the simple line drawing, depicting interaction (according to Rohwer) was used as a benchmark with which to compare the use of imagery as a strategy. A control treatment,
consisting of verbal information only, was included to reaffirm the effectiveness of both imposed visuals and instructions to image.

**Participants**

Participants were 197 students enrolled in three grade levels in a suburban southwest Virginia county. The students were drawn from an upper-middle socioeconomic community which consists primarily of well-educated professionals. Students now attend or will feed into a high school in which approximately 80% of the population is college-bound. By necessity, students were used from intact classes. In the elementary school the entire grade level was included, representing a cross-section of the community. In the junior high and high school, heterogeneously grouped intact classes were used.

**Rationale for Use of the GEFT**

The Group Embedded Figures Test (GEFT) was modeled closely after the individually administered Embedded Figures Test (EFT), to make group testing possible. Seventeen of the eighteen complex figures were taken from the EFT and, as in the EFT, subjects are prevented from viewing the simple and complex figures simultaneously (Witkin, et al., 1971). Correlations between the GEFT and the EFT are "reasonably high" (p. 29). The GEFT is presented in booklet form and consists of 25 (7 practice and 18 scored) shaded complex figures in which one of eight simple figures is embedded. The test is conducted in three timed intervals, one for
the practice items and two for the scored sections. Simple figures are printed on the back cover, allowing the participant to look at each as often as needed but not simultaneously with the complex figures.

Although only norms for college students are included in the manual, the authors suggest that the test may be used with children and that time-limit modifications may help “maximize individual differences with some groups” (Witkin, et al., 1971, p. 28). A pilot study extending the time limit to 10 minutes (rather than 5) for each section when using the test with 10-year-olds is cited. According to the authors, “It seems reasonable that, without changing the format of the test, adjustment of time limits and directions will make possible a flexible instrument for use with groups widely diversified in age and background” (Witkin, et al., 1971, p. 28).

Several researchers have reported successfully using the GEFT with children to differentiate within the group being tested; however, performance is generally expected to be lower for younger children. Witkin, et al. (1971) identified a developmental curve, finding “a marked continuous increase in field-independence for children in the 8- to 15-yr.-age range, followed by a plateau of near absolute stability” (Mahlios & D'Angelo, 1983, p. 424). Based on previous experience with the GEFT, Mahlios & D'Angelo (1983) also used an administration time of 10 minutes for each section with fifth graders. The results of their study confirm the developmental curve and suggest that adult norms cannot be applied to children of this age.
Thompson, Pitts & Gipe (1983) also used the GEFT with fourth, fifth and sixth graders. Using the same rationale as the previously cited study, the time limit was increased to 10 minutes for each section and several of the practice items were presented on an opaque projector. This study also confirmed the developmental hypothesis and the authors concluded that results were "generally favorable with respect to the applicability of the Group Embedded Figures Test with children in Grades 4 through 6" (p. 201).

Kaley (1977) found that, although the GEFT could not be used to predict learning style according to the MLSI, it was an appropriate instrument for assessing field dependence in sixth-grade children. Carrier, et al. (1983) used the GEFT with sixth-grade children based on 1-year test-retest coefficients of stability of .80 and .71 for sixth-grade boys and girls respectively, as reported by Powers and Lis (1977). Powers and Lis (1977) also reported coefficients of internal consistency ranging from .83 to .98 for boys and girls in the same sample.

There is sufficient evidence to substantiate use of the GEFT with children. Extensive research by Witkin, Goodenough & Karp (1976) indicates that degree of field dependence is both developmental and stable, that is "as subjects get older they maintain their relative distances from others along the construct continuum while moving in the direction of increasing field independence" (Thompson, et al., 1983, p. 201). Based on the cited evidence, within-group norms were established separately for each grade level to categorize students as relatively field dependent, neutral, or relatively field independent as compared to their grade-level peers.
Identical administration procedures were used as outlined by Witkin, et al. (1971), with the exception of the time limit for completion of each scored section which was increased to 10 minutes for fourth graders and 7.5 minutes for seventh graders. The 5-minute time limit was maintained for tenth graders.

**Description of Treatment Conditions**

Following administration and scoring of the GEFT, students within each grade level were classified as field dependent, neutral, or field independent. Within each classification, one-third of the students were randomly assigned to each treatment group. The three treatments were conducted within a single class period.

The introductory material and dependent measure were identical for all groups. Students were given an answer booklet (see Appendix C) and pencil and instructed not to open the booklet until told to begin. Individuals were asked to complete personal data on the front of the booklet, including name, age and sex. They were assured that this information would be used for grouping purposes only and that all data would be reported anonymously. They were also assured that performance on this task would in no way affect their grade. The paired-associate memory task was explained and an example was given. Students in each group were given 24 pairs of concrete nouns at 6-second intervals. Immediately following the last pair, students were instructed to open the test booklet and complete as many pairs as possible. Attention was also directed to a question on the back of the test booklet asking them to describe briefly any strategy used to
facilitate recall. This test was not timed. Variations in the treatment conditions were as follows:

**Verbal Only (Control)**
This group viewed slides with the paired words printed in block letters. They were shown an example slide prior to beginning the 24 pairs presented at 6-second intervals. Participants were only told to “try to remember the two words that go together.”

**Imposed Visuals**
This group viewed slides of simple blackline drawings depicting the two nouns interacting. The words were printed in block letters below each picture. The same 6-second interval was used and an example was shown using a blackline drawing of the same word pair used in the control situation. This group was instructed to “use the pictures to help you remember the two words that go together.”

**Instructions to Form Visual Images**
This group viewed slides identical to those viewed by the control group for the same 6-second interval. They were instructed to “try to form an image of the two words interacting during the time between slides.” The same word pair was used as an example and the administrator verbally described several appropriate images.
Materials

Materials included:

- GEFT Test Booklet for each student
- Treatment Test Booklet for each student
- 25 (including 1 sample) slides of paired-associate nouns printed in block letters (2 sets)
- 25 (including 1 sample) slides of simple line drawings of the same paired-associate nouns with words printed in block letters below each picture

Word Selection

It has been established that imagery mnemonic strategies are most effective for concrete words. In order to develop a cadre of stimulus words to use in linguistic studies concerning semantic aspects of abstractness-concreteness, Paivio, Yuille & Madigan (1968) developed a rating procedure for concreteness, imagery and meaningfulness and subsequently rated 925 nouns. Van der Veur prepared a similar list of imagery ratings for 1,000 words frequently used by children. For this study, words were selected that appeared on both lists with imagery and concreteness ratings exceeding 6 on a 7-point scale. All synonyms and homonyms were eliminated and words were randomly paired, being careful to avoid pairing objects with common connections and considering ease of design of the line drawings for the imposed visual treatment. A list of the words selected, along with concreteness and imagery ratings for each word is included in Appendix A.
**Analysis of Data**

A 3 x 3 x 3 Analysis of Variance was used to analyze the data. Due to the expected variance in level of field dependence for children within the age group under consideration, the assignment to three equal groups (field dependent, neutral, field independent) based on peer-group scores is justified. According to Witkin, et al. (1971), level of field dependence is relatively stable and “children tend to hold the same position relative to their age peers...as they grow up, while as a group they show movement toward greater field independence” (Witkin, et al., 1971, p. 5). L. H. Cross (personal communication, April 6, 1989) confirmed this grouping procedure as appropriate. Main effects were considered for cognitive style (field dependent, neutral, field independent), teaching strategy (verbal [control], imposed visuals, instructions to image), and age (fourth, seventh, tenth grade.) Interactions among cognitive style, teaching strategy and age were also of interest.

To fully explain variation that occurred, additional secondary analyses were conducted using one-way analysis of variance. Tukey-Kramer Multiple Comparison Tests were used to ascertain significant differences among group means.
Chapter 3

RESULTS

The purpose of this study was to consider the efficacy of imposed visuals and instructions to form visual images as aids to memory for 197 students exhibiting varying levels of field dependence and ranging in age from fourth grade to tenth grade. The student participants were drawn from a moderately affluent, suburban community in southwestern Virginia. Parents tend to be well-educated professionals who support the public education system. Average standardized test scores for the school populations included typically range from 15 to 20 points above national norms. Approximately 80% of the graduates attend college.

To determine level of field dependence, the Group Embedded Figures Test was administered to 65 students in grade four, 72 students in grade seven and 60 students in grade ten. The distribution of these scores is reported in Table D-1 in Appendix D. As expected, younger students scored lower as a group than did their older counterparts, therefore, assignment to three stratifying conditions was as indicated in Table 1. It should be noted that overlap among grade levels only occurred between students classified as field dependent and neutral or between those classified as field independent and neutral. No student with a score higher than 9 was classified as field dependent and no student with a score lower than 12 was classified as field independent.
Table 1

Group Embedded Figures Test Results by Grade Level and Field Dependence Classification

<table>
<thead>
<tr>
<th>Group</th>
<th>FD</th>
<th>Neutral</th>
<th>FI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 4</td>
<td>0 - 5</td>
<td>6 - 11</td>
<td>12 - 18</td>
</tr>
<tr>
<td>n = 65</td>
<td>n = 21</td>
<td>n = 20</td>
<td>n = 24</td>
</tr>
<tr>
<td>Grade 7</td>
<td>0 - 8</td>
<td>9 - 14</td>
<td>15 - 18</td>
</tr>
<tr>
<td>n = 72</td>
<td>n = 23</td>
<td>n = 24</td>
<td>n = 25</td>
</tr>
<tr>
<td>Grade 10</td>
<td>0 - 9</td>
<td>10 - 15</td>
<td>16 - 18</td>
</tr>
<tr>
<td>n = 60</td>
<td>n = 20</td>
<td>n = 20</td>
<td>n = 20</td>
</tr>
</tbody>
</table>
A three-way Analysis of Variance was employed to conduct a statistical comparison of the three treatment groups and the additional independent variables of grade level and cognitive style. The alpha level was set at .05 for all analyses. The results of this ANOVA are presented in Table 2. Means and standard deviations for all main effects are reported in Table 3; means and standard deviations for all cells are included in Table E-1 in Appendix E. As indicated in the Summary ANOVA Table, significant differences were found to exist for grade level, $F(2,170) = 7.88, p < .05$; cognitive style, $F(2,170) = 4.96, p < .05$; and treatment, $F(2,170) = 50.29, p < .05$. No interactions were indicated.

The dependent measure was a written test of immediate recall for 24 paired-associate nouns developed for use within this study. Reliability for the single administration of this instrument was estimated to be .87 using the Kuder-Richardson formula 21 (Ferguson & Takane, 1989).

Additional analyses were conducted in an effort to answer individual research questions. Specific results relating to each hypothesis are presented following Tables 2 and 3.
Table 2
Summary ANOVA Table for Grade, Style and Treatment

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DF</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade Level</td>
<td>2</td>
<td>287.596</td>
<td>143.798</td>
<td>7.88</td>
<td>.0005*</td>
</tr>
<tr>
<td>Cognitive Style</td>
<td>2</td>
<td>180.912</td>
<td>90.456</td>
<td>4.96</td>
<td>.0081*</td>
</tr>
<tr>
<td>Grade x Style</td>
<td>4</td>
<td>107.245</td>
<td>26.811</td>
<td>1.47</td>
<td>.2136</td>
</tr>
<tr>
<td>Treatment</td>
<td>2</td>
<td>1834.949</td>
<td>917.475</td>
<td>50.29</td>
<td>.0001*</td>
</tr>
<tr>
<td>Grade x Treatment</td>
<td>4</td>
<td>143.573</td>
<td>35.893</td>
<td>1.97</td>
<td>.1017</td>
</tr>
<tr>
<td>Style x Treatment</td>
<td>4</td>
<td>94.058</td>
<td>23.515</td>
<td>1.29</td>
<td>.2763</td>
</tr>
<tr>
<td>Grade x Style x Treatment</td>
<td>8</td>
<td>148.131</td>
<td>18.516</td>
<td>1.02</td>
<td>.4266</td>
</tr>
<tr>
<td>Error</td>
<td>170</td>
<td>3101.444</td>
<td>18.244</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* p<.05
# Table 3
**Table of Means and Standard Deviations by Main Effects**

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grade Level</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fourth</td>
<td>65</td>
<td>15.45</td>
<td>5.42</td>
</tr>
<tr>
<td>Seventh</td>
<td>72</td>
<td>16.19</td>
<td>5.59</td>
</tr>
<tr>
<td>Tenth</td>
<td>60</td>
<td>18.23</td>
<td>5.21</td>
</tr>
<tr>
<td><strong>Cognitive Style</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field Dependent</td>
<td>64</td>
<td>15.09</td>
<td>5.91</td>
</tr>
<tr>
<td>Neutral</td>
<td>64</td>
<td>17.23</td>
<td>4.64</td>
</tr>
<tr>
<td>Field Independent</td>
<td>69</td>
<td>17.32</td>
<td>4.64</td>
</tr>
<tr>
<td><strong>Treatment</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>68</td>
<td>12.35</td>
<td>5.64</td>
</tr>
<tr>
<td>Imposed Visuals</td>
<td>66</td>
<td>18.36</td>
<td>3.89</td>
</tr>
<tr>
<td>Imagery</td>
<td>63</td>
<td>19.24</td>
<td>3.96</td>
</tr>
</tbody>
</table>

N = 197 \[ \bar{X} = 16.57 \]

NOTE: Maximum possible score = 24.
Research Question 1

Is there a difference in the effect of teaching strategy (instructions to image versus imposed visuals) on immediate recall for students differing in cognitive style (field dependent, neutral, field independent)?

H #1A Field-independent students will perform better than field-dependent students under all conditions.

The analysis of variance indicated a significant difference in performance due to cognitive style, $F(2,170) = 4.96, p < .05$. Group means for the cognitive style main effect were: field dependents, 15.09; neutrals, 17.23; and field independents, 17.32. Tukey-Kramer Multiple Comparison Tests indicated that differences occurred between field-independent and field-dependent students, $Q = 4.25, p < .05$; and between neutral and field-dependent students, $Q = 4.01, p < .05$. Students classified as neutral did not differ from those classified as field independent, $Q = .172, p > .05$. Cognitive style did have an effect on immediate recall with field-independent and neutral students scoring significantly higher than field-dependent students.

H #1B Field-dependent students will perform better in the imposed visual situation, than in imagery or control.

To compare the performance of only field-dependent students, without regard to grade level or to the performance of the students classified as neutral and
field independent, a secondary analysis was conducted using one-way Analysis of Variance. Table 4 summarizes these results.

Table 4
Summary ANOVA Table
Comparison of Three Treatment Conditions for All Field Dependents

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DF</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>2</td>
<td>840.91</td>
<td>420.455</td>
<td>18.82</td>
<td>.0001*</td>
</tr>
<tr>
<td>Error</td>
<td>61</td>
<td>1362.528</td>
<td>22.337</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* p<.05

There was a significant difference in the treatment means, $F(2,61) = 18.82$, $p < .05$. The group means for all field-dependent students under the three treatment conditions were as follows: Control, 10.26; Imposed Visuals, 17.57; and Imagery, 18.05. Using Tukey-Kramer Multiple Comparison Tests, significant differences were determined to exist between Control and Visuals, $Q = 7.25$, $p<.05$ and between Control and Imagery, $Q = 7.62$, $p<.05$. There was not a significant difference between the imposed visual and imagery conditions, $Q = .46$, $p>.05$. This hypothesis was not confirmed in this study; field-dependent students did not perform better under the imposed visual as compared to the imagery condition.
H #1C For field-independent students, there will be no difference in performance under the imposed visual and imagery conditions.

Performance of all field-independent students under the three treatment conditions was also analyzed using one-way Analysis of Variance. These results are summarized in Table 5. Significant differences were indicated, $F(2,66) = 19.06$, $p<.05$, among the following group means: Control, 12.61; Imposed Visuals, 18.79; and Imagery, 20.64. Multiple comparison tests, using the Tukey-Kramer method, determined the differences to be between Control and Imposed Visuals, $Q = 6.52$, $p<.05$) and between Control and Imagery, $Q = 8.29$, $p<.05$). There was no difference in the group means for Imposed Visuals and Imagery $Q = 1.93$, $p>.05$, thereby confirming this hypothesis.

Table 5
Summary ANOVA Table
Comparison of Treatment Conditions for All Field Independents

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DF</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>2</td>
<td>804.458</td>
<td>402.229</td>
<td>19.064</td>
<td>.0001*</td>
</tr>
<tr>
<td>Error</td>
<td>66</td>
<td>1392.528</td>
<td>21.099</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* $p<.05$
Research Question 2
Is there a developmental difference in the effect of teaching strategy (instructions to image versus imposed visuals) among age groups (fourth, seventh, and tenth graders)?

H #2A Older students will perform better than younger students regardless of treatment.

The summary ANOVA Table (Table 2) shows a significant effect, $F(2,170) = 7.88, p<.05$ for grade level. The mean scores by grade level (see Table 3) for all treatment groups and styles were: fourth grade, 15.45; seventh grade, 16.19; and tenth grade, 18.23. Comparisons using the Tukey-Kramer method indicated significant differences to occur between fourth grade and tenth grade, $Q = 5.14, p<.05$; and between seventh and tenth grade, $Q = 3.95, p<.05$. There was not a significant difference, $Q = 1.43, p>.05$ between fourth and seventh grade. Tenth grade students scored significantly higher than did students in fourth grade and seventh grade, thus confirming this hypothesis.

H #2B Under the imagery condition, older students will achieve a significantly higher recall score (in comparison to control of the same age) than younger students.
The overall Analysis of Variance indicated no interaction between the independent variables of age and treatment, $F(4, 170) = 1.967, \ p > .05$. This hypothesis of interaction between age and treatment is, therefore, not confirmed.

H #2C Performance in the imposed visual condition will not differ significantly across age levels.

One-way analysis of variance was used to compare recall scores by grade level for only the students assigned to the imposed visual condition. The results of this analysis are reported in Table 6. There were, as hypothesized, no differences, $F(2, 63) = .349, \ p > .05$, in performance of fourth, seventh and tenth graders in the imposed visual treatment.

Table 6

Summary ANOVA Table
Imposed Visual Condition by Grade Level

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DF</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade Level</td>
<td>2</td>
<td>10.777</td>
<td>5.388</td>
<td>.349</td>
<td>.7067*</td>
</tr>
<tr>
<td>Error</td>
<td>63</td>
<td>972.496</td>
<td>15.436</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* $p > .05$
Research Question 3

Is the effect of teaching strategy (instructions to image versus imposed visuals) for students of varying cognitive styles (field dependent, neutral, field independent) different at varying age levels (fourth, seventh, tenth grade)?

There was no interaction among grade level, cognitive style and treatment (see Table 2), $F(8,170) = 1.015, p>.05$. The following hypotheses are, therefore, not confirmed by this study:

H #3A Older field-dependent students will perform better in the imagery condition (in comparison to control) than will younger field-dependent students.

H #3B Younger field-independent students will perform better in the imagery condition (in comparison to the control group of the same age) than will older field-independent students (ceiling effect.)
Summary

A three-way Analysis of Variance indicated significance for all main effects considered in this study. Hypothesized interactions were all rejected, however. Secondary analyses of the main effects produced the following results:

1. Students in tenth grade scored significantly higher on the recall test than did students in fourth grade and seventh grade;

2. Students classified as field independent and neutral scored significantly higher than those classified as field dependent; and

3. Students using imposed visuals and instructions to image scored significantly higher than the control group.
Chapter 4

DISCUSSION

The purpose of this study was to investigate the relationship of cognitive style to the efficacy of imposed visuals and instructions to form visual images as aids to immediate recall memory. Also of interest was the developmental effect for students ranging in age from upper elementary to high school. It was hypothesized that memory would be better for older students compared to younger students and for field-independent students compared to field-dependent students. From the review of literature, it was assumed that the imposed visual and imagery conditions would yield higher scores than the control condition. Interactions were hypothesized, however, with field-independent students expected to perform better in the imagery condition than field-dependent students due to their ability to impose structure. Older students were also expected to profit more (in relation to control of the same age) from imagery than were younger students, due to the hypothesis that ability to form visual images is developmental.

Data was analyzed using three-way analysis of variance. All three main effects, grade level, cognitive style and visual strategy, produced significant results. As postulated, recall memory was better for older students, field independents, and students in the imposed visual and imagery conditions. Neither cognitive style, nor age, interacted with visual treatment, however. The hypothesized relationships among style, age, and visual condition were not evident in this study.
The cognitive style factor produced a noteworthy effect in that students classified as field independent and those classified as neutral exhibited mean recall scores that were very close together (field independent, 17.32; neutral, 17.23). Both groups scored significantly higher than the field-dependent students whose mean score was 15.09. This indicates that slightly decreased memory capacity may be related to a tendency toward field dependence for the students in this sample. It should be noted that level of field dependence has not been shown to correlate with overall intelligence, although relationships have been established with some measures of visual/spatial ability (Witkin & Goodenough, 1981; Witkin, et al., 1971; Witkin, et al., 1971). The present study did not confirm a relationship between field dependence and performance on a visual task, however. The specific visual tasks required in this study (use of imposed visuals or generation of imagined visuals) did not interact with cognitive style. Students exhibiting different cognitive styles on the GEFT were not found to differ in their ability to profit from the imposed visual or imagery conditions.

Determination of cognitive style, for use as a stratifying variable, was a challenging aspect of the current study due to the developmental nature of field dependence and the lack of a single test with established norms for the age groups included. Following guidelines delineated by the authors of the Group Embedded Figures Test (which only includes norms for adult college students), and recommendations of several previous researchers, the GEFT was used with all three age groups (Thompson, et al., 1983; Witkin, et al., 1971). The only
modification was the extension of the time limit to 10 minutes for fourth graders and 7.5 minutes for seventh graders for each scored section. The *a priori* decision to include a neutral group was due primarily to concern regarding the grade-level norms that had to be established in order to form treatment groups of equivalent sizes. It was hoped that the neutral category would serve as a buffer to prevent overlap of students classified as field dependent and field independent among the three grade levels. This was, in fact, the case (see Table D-1 in Appendix D for GEFT Frequencies obtained in this study). Table 1 indicates the ranges used to assign students to each style group. The expected developmental growth on the field-independence scale was evident, with students at each successive grade level under consideration scoring higher as a whole. This portion of the study serves to confirm the contention that students develop field independence as they grow older, while maintaining a relative position within their peer group (Mahlios & DiAngelo, 1983; Witkin & Goodenough, 1981; Witkin, et al., 1967; Witkin, et al., 1971).

Developmental effects were also apparent within the significant effect for grade level. Although the expected upward trend is evident, significant differences were not found at equal chronological intervals. Mean grade-level scores for students, without regard to cognitive style or treatment group (from Table 3), are as follows: fourth grade, 15.45; seventh grade, 16.19; and tenth grade 18.23. Statistically significant differences occurred only between the fourth and tenth grades and between the seventh and tenth grades, indicating an uneven growth pattern. It is not possible to draw specific conclusions regarding performance of the seventh grade students from this effect, however, due to the relatively small
increase in mean score from fourth to tenth grade and the large variances (see Table 3) for all three groups. There is some evidence, however, that (at least in this sample) seventh graders were much closer to fourth graders in their performance than they were to tenth graders.

The use of student-generated strategies to enhance memory was also present in a developmental fashion, with older students more frequently reporting spontaneous use of mnemonic aids. While only 14% of fourth graders reported using any mnemonic or elaborative device, this figure grew to 50% of the seventh graders and 63% of the tenth graders. It was not possible, within the scope of the present study, to ascertain whether students have formulated these memory strategies independently or if they have received instruction in their use. On the back cover of the paired-associate test booklet, all students were asked to "Please describe (briefly) any method you used to help you remember the word pairs." The majority of students did not respond, answered "none," or referred to the provided pictures (imposed visual group) or imagery instructions (imagery group). To determine what methods students used in the absence of instructions, all responses given by students assigned to the control groups were analyzed yielding informative results. Only 3 of 22 fourth graders in the control group reported using any strategy to aid memory. All three students indicated that they had attempted to put the words in sentences or phrases. Only one of the three students mentioned "meaning." Use of semantic or mnemonic organizational strategies was very limited within this age group.
Half of the 24 seventh graders reported strategies, with 10 respondents indicating semantic elaboration, such as “putting together ideas” or “relating ideas to each other.” One of these students reported trying to find a “resemblance.” The idea of forming relationships with meaning was very important to this age group. In addition, two students in the seventh-grade group described using imagery. One “tried to visualize pictures.” Another employed the interactive feature, reporting that she “put a picture in my mind of what they looked like together.” It was apparent that students of this age had become much more sophisticated in applying such strategies.

Of the 22 students in the tenth-grade control group, 14 reported using a strategy. The methods were equally divided with 7 reporting semantic associations regarding relationships or sentences and 7 reporting the use of visual imagery. Again, the interactive concept arose spontaneously (or from previous experience) with students explaining: “I pictured in my mind, seeing the words together;” and “I imagined one word doing the other.” One girl (who was able to recall 23 of the 24 pairs) said, “I associated each word with the other, picturing a logical scene which they would be in.” Another (who scored 19 on the memory test) reported, “I looked at the first word and thought of a picture in my mind to associate that word with the next.” She recounted an elaborate example taken from a currently popular motion picture. Generally, the tenth-grade students who reported using a strategy were very precise, giving thorough descriptions indicative of continued growth in elaborative, semantic thought processes. It may be that older students have simply acquired the propensity to organize factual information. They may have developed
organizational study habits not yet apparent in younger children to compensate for larger amounts of information processing that is required of them.

Also interesting to note is a possible relationship between level of field dependence and the spontaneous use of a strategy by students in the control groups. Of the 29 control-group students who reported using strategies, only 3 were classified as field dependent (all tenth graders), 16 as neutral and 10 as field independent. This supports Witkin's theory that field-independent individuals tend to impose structure on unstructured situations, while field-dependent individuals tend to accept the field as given (Witkin & Goodenough, 1981; Witkin, et al., 1977; Witkin, et al., 1971). This analysis of control-group responses clearly indicated that field-independent students were more likely to report a strategy, as were older students.

It is also necessary to consider that the unsolicited employment of these strategies somewhat invalidated the underlying concept of the control group, thereby confounding comparisons between control and imagery. The control situation was transformed by the participants from a measure of memory without strategy to a measure of the students' ability to spontaneously utilize such a strategy. The resulting means (see Table E-1 in Appendix E) for the three control groups (without regard to style) do seem somewhat disproportionate. The control group mean for tenth graders (15.18) is substantially higher than the mean for seventh graders (11.71) and fourth graders (10.23). It is doubtful that these reported mnemonic and semantic uses within the control group significantly
affected the analysis of the hypotheses under consideration; however, it is apparent that the use of such strategies served to raise the mean scores, and that the results obtained when comparing imagery to control are somewhat confounded by the spontaneous use of imagery and elaboration within the control groups.

The main effect for visual strategy (treatment) was an expected result (Finke, 1980; Levin, et al., 1983; Paivio, 1971, 1986; Richardson, 1980); the imposed visual and imagery conditions did not differ significantly, with both supplying equal support to the learner. Although the hypothesized interactions among the imposed visual and imagery conditions, cognitive style, and grade level were not present, this study did reaffirm the value of visual representations, both pictorial and imaginal, as aids to verbal learning (Paivio, 1971, 1986; Richardson, 1980). For a verbal task of this nature and students in these age groups, instructions to form visual images and the line drawings were equally effective. This is consistent with previous research findings (Finke, 1980; Forisha, 1975; Hanley, 1988; Yuille & Marschark, 1984).

Paivio (1980) suggests that imagery might serve as an audiovisual aid to students. He asserts that images "can be intentionally and systematically used as the informational base for cognitive operations and as an aid to new learning" (Paivio, 1980, p. 295). Instructions to form visual images have been shown in this study to be as effective as prepared visual representations. This indicates that imagery instructions can be used effectively by teachers in the absence of prepared visuals to supplement verbally presented material. It would also follow that these
instructions may be particularly helpful, as are visual aids, when guiding students toward the formation of cognitive representations of complex conceptual relationships. Paivio (1980) also suggests that audiovisual programs “be constructed so that they encourage learners to generate their own anticipatory images regarding the outcome of an event” (p. 308). Application of visual imagery strategies in learning situations is a rich area for additional exploration. Designers of media should consider Paivio's suggestion of image formation that interacts with the media. Teachers should incorporate self-generated images to replace visuals when appropriate or supplement existing visuals, thus maximizing their potential (Paivio, 1980).

Although the present study failed to substantiate the expected interactions, it did confirm existing theories relative to the developmental nature of memory capacity and imagery ability (Forisha, 1975; Richardson, 1980; Yuille & Marschark, 1984). It also confirmed the relationship between field independence and memory (Witkin & Goodenough, 1981; Witkin, et al., 1977; Witkin, et al., 1971), with the superiority of the field-independent and neutral groups evident across all visual treatments. The lack of interaction between style and visual treatment may be because the paired-associate task as presented was not challenging enough to differentiate among levels of cognitive style. It would be desirable to repeat this study, substituting a more difficult memory task in which disembedding (for the imposed visual group) and embedding (for the imagery group) would be required. Unfamiliar prose material (Carrier, 1983; Guttman, et al., 1977; Levin, 1981; Levin, et al., 1983) might serve this function by providing the necessity for
more discrete organization of concepts. Time may also be a variable of interest in future studies. A shorter time between word or word/visual presentations might discriminate more clearly among students of varying cognitive styles and ages (Pressley & Levin, 1980). Explicit knowledge of the simple task, along with ample time, may have allowed students classified as field dependent to impose structuring techniques that they may not have imposed if time were shortened or if the task were more difficult.

An uncontrolled factor in this study was the generally high socioeconomic and educational level of the community from which the students were drawn. There is a possibility that the level of sophistication affected the results. In a review of imagery strategies related to learning, Alesandrini (1982) indicated that socioeconomic status has been found to be a determining factor relating to the use of imagery to enhance memory. For this reason, future research efforts might replicate this study using a cross-section of rural, urban, and suburban populations.
Summary

Although this study did not generate the expected interactions, it did serve to confirm several theories of importance to the researcher in instructional technology. Significant results were obtained to indicate that older students have a greater capacity than do younger for immediate recall of information. Also of note is the reaffirmation of the effectiveness of visuals used to supplement verbal communications, even when the visuals are generated within the individual through imagery. This is strong confirmation for Paivio's dual coding theory. Self-generated imaginal representations were as effective as line drawings for all students, regardless of age or style. Caution should be exercised, however, in the application of imagery to situations that do not involve concrete verbal communications (Alesandrini, 1982; Geisen & Peeck, 1984; Paivio, 1971, 1986). This study only considered memory for nouns that were judged to be concrete and easy to image. Quite different results might be obtained using abstract words or more complex associations (Hunter, et al., 1983).

Students in this study classified as field-independent and neutral scored significantly higher on the recall test than did their field-dependent counterparts. This is explained by the analytical nature of the paired-associate task and the tendency of these individuals to impose a structure to organize experiences, thus making them more memorable. It is important that instructional designers consider these cognitive style differences, supplying the organizational structure to the student who needs this assistance. Using visual representations, whether they are
actual pictures or specific instructions to guide student-generated imagery to supplement verbal content should not be overlooked.
References


Van der Veur, B. W. (1975). Imagery rating of 1,000 frequently used words. *Journal of Educational Psychology, 67*(1), 44-56.


Appendix A

Imagery & Concreteness Ratings of Experimental Words

Experimental Word Pairs
# Imagery & Concreteness Ratings

of

**Experimental Words**

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<th>van der Veur</th>
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Appendix B

Visuals Used in Imposed Visual Condition
CAR - LAKE

CHAIR - ROCK

BUTTERFLY - CANDY

KING - BUTTER

AMBULANCE - HOUSE

ARM - DOOR
Appendix C

Test Booklet
Memory Test

Name____________________________

Grade_______________Age ________

Do not open booklet until instructed to do so.
Please write as many words as you can remember to complete the pairs presented.

1. BIRD
2. ELEPHANT
3. CLOCK
4. CORN
5. FOX
6. TOAST
7. CAT
8. BOY
9. DRESS
10. TRUCK
11. CHURCH
12. DOLL
13. CAR
14. CHAIR
15. BUTTERFLY
16. KING
17. AMBULANCE
18. ARM
19. WINDOW
20. BOOK
21. FIRE
22. GIRL
23. HORSE
24. STREET
Appendix D

Group Embedded Figures Test Frequencies
Table D-1

Group Embedded Figures Test Frequencies

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Appendix E

Table of Means and Standard Deviations
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Individual Cell Means and Standard Deviations

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