

EFFECT OF RESTRUCTURING TRAINING
AND FIELD-DEPENDENCE-INDEPENDENCE

by

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Dissertation submitted to the Faculty of the
Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree of

DOCTOR OF EDUCATION

in

Curriculum and Instruction

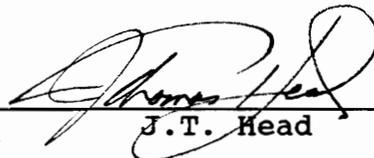
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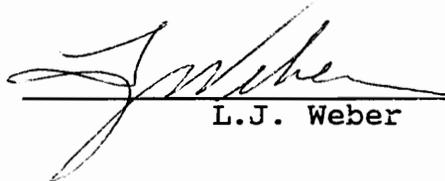
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(ABSTRACT)

Herman Witkin's research in differentiation theory proposed a conceptual framework describing the cognitive style known as field-dependence-independence. The operational measures of this construct are restructuring skills and interpersonal competencies, and were originally conceived to be fixed in an individual. A recent reconceptualization, however, suggested that there may be some malleability in learning strategies that flow from cognitive style. Learners predisposed to field dependence might gain access to restructuring skills brought to problem-solving situations by field independents. Thus this study under-

took to examine the effects and practicability of restructuring training as a means of addressing individual learner differences.

Community college students were identified on the field-dependence-independence continuum using the Hidden Figures Test. Students in the experimental group received training in use of restructuring strategies. All participants were given subsequent tasks requiring the employ of restructuring strategies. These posttest tasks included a visual disembedding task, a verbal disambiguating task, and a task of visual perspectivism. Training effect was observed in field dependents for all three test tasks.

ACKNOWLEDGEMENTS

To complete this undertaking has required the support and sacrifice of those close to me. Grateful thanks go to Dr. Mike Moore whose quiet, constant inspiration and leadership moved this project to completion.

My thanks also to my committee members, Dr. John Burton, Dr. Tom Head, Dr. John Moore, and Dr. Larry Weber, whose interest was matched by their insight into my project.

Ginny McClure and Paul Musick have given so much more than friendship requires; for this they will always be my creditors.

Thanks, too, to the Fellowship. I've finally brought closure to the unfinished business of our group. The inspiration of my Fellows was never far from this effort.

Finally, I am grateful to my wife Jane, whose encouragement and love was a rock throughout.

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Chapter I

INTRODUCTION

Herman Witkin's studies of perception of the upright led to development of a conceptual framework that described a dimension of cognitive style known as field-dependence-independence. The larger construct has become known as differentiation theory, or psychological differentiation (Witkin, Goodenough, & Oltman, 1979). The constructs within this cognitive style are described as bipolar and value-neutral (Witkin, 1978), and have been expanded to account for the evolving findings of recent years.

Witkin, Goodenough and Oltman (1979) proposed a model which had differentiation as it's apex, with self-non-self segregation as one facet of differentiation, represented by field-dependence-independence (F-D-I). At the lowest level (most fundamental) of the F-D-I construct are restructuring skills and interpersonal competencies, which are the operational measures of the field-dependence-independence construct. Thus Witkin related field-dependence-independence to many diverse aspects of personality and social functioning. Werner (1957) added depth to this model with his idea of mobility-fixity in expressing cognitive style. He states that, in the course of development, global or undif-

ferentiated cognitive structures become slowly differentiated and hierarchically integrated, more articulated and organized.

While in its earliest conceptualizations, Witkin noted stability in the construct across longitudinal studies, implying that changing field-dependence-independence through training or therapy was doubtful (Witkin, 1965). However, in a more recent reconceptualization of differentiation theory, Witkin "considered the possibility of inducing change more seriously" (Korchin, 1981). Witkin (Witkin, Moore, Goodenough, & Cox, 1977) said "training...would, according to our hierarchical model, contribute to increased skill in cognitive restructuring ...". He further states that "there is some suggestion as well that training in restructuring as a general competence may result in enhancement of performance on particular restructuring dimensions" (Witkin, et al, 1977, p. 55).

Results of training programs as measured by embedded figures tests are not entirely consistent, but largely support the training hypothesis (McCord, 1973; Parente & O'Malley, 1975; Salome & Reeves, 1972; Szeto, 1975). Witkin and Goodenough state in "Origin of Cognitive Style" (1981) that "...efforts which result in transfer of training to other test materials than those used in training

clearly have more important implications for both theory and educational applications" (p. 52).

Thus, it was the purpose of this undertaking to determine the practicability, if any, of training effects within the hierarchical model for field dependence. Witkin noted both conceptual and practical implications for such research. On the one hand, the postulates of his differentiation model would be further endorsed. Practically, Witkin states that "educational programs (might) be devised in which the training given would transfer to functions related to, but not specifically represented in, the program itself". He further cites the need for "much work", and describes such work as "feasible" and "clearly needed" (p.61).

From Witkin, et al, (1977) the following statement encourages this research:

"We do not yet know what needs to be done, or how far it is possible to progress in training students to move outside the channels into which we now find them directed by their cognitive styles. The apparent malleability of learning strategies flowing from cognitive styles encourages us to believe that such movement can be achieved" (p. 62).

In this context training in restructuring strategies would address individual learner differences beyond Skinnerean research that dealt largely with rate of learning. Dif-

ferentiation theory, as it applies to F-D-I and cognitive restructuring, deals with learner differences in terms of cognitive style.

Need For The Study

Much research has dealt with the identification of differences among individual learners in terms of cognitive and perceptual characteristics. These efforts have mainly concentrated on manipulating (or restructuring) instructional tasks, rather than addressing the restructuring strategies of the learner (Clark & Saloman, 1986). Relative to the field-dependence-independence construct, there is little research regarding the effectiveness of attempting to teach field independent restructuring strategies to those field dependent individuals lacking in the ability to restructure. Restructuring ability is necessary to solve problems where there is an embedding context, a problem involving perspectivism, or where there is ambiguous verbal or visual information. Most studies focus on embeddedness and therefore suggest that instructional developers should design learning materials in which cognitive content is not embedded in a competing or ambiguous field.

From an instructional design standpoint, efforts continue to organize, sequence, cue, or divide information for

the learner, without regard to the possibility of providing restructuring strategies which enable the learner to do this for himself. The possibility must be explored that, if these strategies can be identified and learned, they may be transferred to subsequent tasks that call for use of similar strategies.

Most studies concerned with determining the relationship between cognitive style and design of instructional strategies have manipulated the presentation strategy. Strategies that impose structure on visual fields via supplantation, cueing, advance organizers, enlargement, shading, or the use of color, etc., attempt to compensate for the restructuring skills absent in field dependent learners (French, 1983; Salomon, 1970). The literature supports the notion that field dependent learners benefit from the restructuring aspect of these strategies, while field independent learners are not hindered by this imposed structure (Britain, 1979; Fleming, et al, 1968; Grieve & Davis, 1971; Satterly & Telfer, 1979).

Instructional activities designed with a provision for structure at acquisition seem to enhance the field dependent student's performance on tasks requiring those processing abilities possessed by field independents (Klein & Frank, 1985). These tasks include visual disembedding

tasks, perspective tasks, and verbal disambiguation tasks that are readily solved by field independent individuals. Their analysis and restructuring abilities are problem-solving strategies to which field dependent learners appear not to have access (Davis & Cochran, 1982; Witkin, Oltman, Raskin, & Karp, 1971). The field dependent's operational strategies are characterized by interpersonal competencies rather than restructuring ability.

Design of visual instructional materials may account for a field dependent learner's ability to disembed a specific message from a certain context, but does little or nothing to prepare the learner for subsequent uncued restructuring tasks. The visual task has been manipulated, rather than involving the abilities of field dependent learners to restructure material.

Slymansky and Yore (1980) explored such structuring of learning environment to match the learning style of students. While bringing into focus the important roles of such strategies, these proposals require that the relationship between learner and task must be altered or manipulated in a way not always readily accessible. That is to say that resources of time, expertise, and money may not be available to routinely address differences among learners, with respect to cognitive style or any other variable.

Instructional designers have studied the F-D-I construct with the belief that instructional materials might be designed and used to compensate for individual student differences (Ausburn, 1978; Divesta, 1975). The materials that would emerge would be so structured as to eliminate cognitive style bias against the field dependent (Crow & Piper, 1985). Media modalities, protocols, and other interventions have been examined, with the intention of affecting the relationship between the learner and the task.

The question that suggested itself was whether it may be possible to provide field dependent learners with a hierarchical schema related to restructuring, by way of training in restructuring strategy development and selection. A few experts have related restructuring ability to general intellectual functioning, but most others have empirically linked it to field-dependence-independence perceptual functioning. It would seem most appropriate to explore means by which cognitive or perceptual style differences might be overcome to the benefit of heterogeneous learners such as community college students.

Purpose of the Study

The study was undertaken to ascertain whether restructuring strategies that characterize the field independent perceptual type could be described and taught to adult field dependents, and successfully applied to certain visual and verbal restructuring tasks. The literature characterizes field dependents and field independents as equals in ability, so the treatment attempted to increase participant performance on tasks that specifically require restructuring. It was assumed that the difference between subjects is not due to difference in ability.

If uncued restructuring tasks could be solved by field dependent learners as a result of having learned and implemented restructuring strategies native to the field independent perceptual type, there are practical implications for the instructional designer. Educational media would, of course, continue to be designed with cues and organizers to help field dependent learners, but specific restructuring strategies could also be suggested by the designer.

These strategies would aid and guide learners in breaking down complex stimuli, or provide them an alternate structure where ambiguity and salience embed or obscure the task's solution. If the learner could be trained to master and select appropriate problem-solving strategies,

both the learner and the designer might bring restructuring to learning tasks. Experience in implementing these strategies might lead to spontaneous use in breaking the Gestalt of a complex design, moving the learner from a global to a more articulated survey of visual material. This idea agrees with the concepts of mobility-fixity suggested by Werner (1957) and cognitive flexibility (Battig, 1979) but generally thought to describe only field independents.

No evidence says training will change perceptual type, but it may influence how cognitive style is manifested. If field independents can be mobile on the F-D-I dimension (Witkin, 1971) developing and learning interpersonal skills and strategies that aren't native to their perceptual type, the model for field dependents should be comparable in the direction of learning and developing skills in cognitive restructuring.

The study addressed the possibility of identifying restructuring strategies among field independent learners, and teaching these strategies to field dependent learners. These learners were then given tasks designed specifically to incur the use of restructuring strategies for successful solution. Tasks requiring other problem solving strategies and techniques were not addressed by this study.

The following research questions will be addressed, and will be the basis for the research hypotheses for the study:

- 1) Will field dependent learners be able to learn and practice field independent type strategies?
- 2) Will field-dependent-independent learners' performance on a subsequent embeddedness task show gain in restructuring ability?
- 3) Will field-dependent-independent learners' performance on a subsequent task of visual perspectivism show gain in restructuring ability?
- 4) Will field-dependent-independent learners' performance on a subsequent task of verbal disambiguation show gain in restructuring ability?
- 5) Will there be a greater training effect observed in any of the three restructuring tasks for field-dependent-independent learners?

Limitations of the Study

The treatment time was limited to two one-class periods approximately 75 minutes each. It was the purpose of this experiment to examine the effect of the treatment, but not its longevity, nor the ideal amount of such training, nor the effect of continued restructuring strategy training on field-dependence-independence. The identification of a short-term effect might be the basis for recommending further study. Evidence that such a treatment might be effective has been encouraged by previous research. Egeland (1974) discovered that the effect of training in visual

search strategies lasted for at least two months in a study involving children who demonstrated impulsive behavior.

No attempt was made to accommodate or explain individual information processing differences, or other elements of cognitive style beyond the scope of this study. The sample was limited to students of Virginia Highlands Community College, Abingdon, Virginia.

Organization of the Study

Chapter II presents the literature related to field-dependence-independence and to restructuring training. Chapter III contains the methods and procedures of the study, including research design and experimental hypotheses. Chapter IV presents an analysis of the data and findings obtained. Chapter V includes a summary of the study, a discussion of the results, conclusions derived from the findings, and implications and suggestions for further research.

Chapter II

REVIEW OF THE LITERATURE

Perception and Cognitive Style

Over the past 30 years, over 3800 studies have been conducted to determine which cognitive processes and perceptual characteristics were correlates of cognitive style (Cox, 1980; Cox & Gail, 1981; Cox & Witkin, 1978; Kelly, 1985; Witkin, Cox, Friedman, Hrishikesan, & Seigal, 1974; Witkin, Oltman, Cox, Ehrlichman, Hamm, & Ringer, 1973).

Witkin (1950) and others have studied perception of the upright as a personality dimension related to the perceptual ability of an individual. Differences in learner response along perceptual lines is a "longstanding, well-established fact in educational psychology" (Salomon & Clark, 1977; Snow & Lohman, 1984, p. 347).

Witkin (1950) contended that the perceptual abilities needed to successfully work with spatial problems are closely related to the cognitive dimension field-dependence-independence. He noted that the individual variations in modes of perception rose from stylistic dimensions, or cognitive styles. Messick (1970)

described cognitive style as information processing habits representing certain typical modes of perceiving, thinking, remembering, and problem solving. He noted nine bipolar dimensions of cognitive style: field-dependence-independence, scanning, breadth of categorizing, conceptualizing style, cognitive complexity-simplicity, reflectiveness-impulsivity, leveling-sharpening, and tolerance for ambiguity. Among these, the F-D-I construct is most researched, and has widest application to educational problems (Witkin, Moore, Goodenough, and Cox, 1975).

Herman Witkin's psychological differentiation theory attempts to explain the relationship of cognitive styles to perceptual origins, within the conceptual framework of articulated, versus global, functioning. When cognitive and perceptual functioning are brought together as stylistic dimensions, it allows an expectation of self-consistency across all domains. (Witkin, 1971).

Witkin conducted studies dealing with perception of the upright, leading to other experiments dealing with participants' ability to perceive a part within a larger whole. Field-dependence-independence became the operational measure of these experiments, with cognitive restructuring skills or interpersonal skills the attributes ascribed to the extremes of the bipolar continuum. Studies of cognitive skills related to restructuring have employed percep-

tual tasks (Frank & Noble, 1986; Kelly, 1985; Nebelkopf & Dreyer, 1970; Witkin, Dyk, Faterson, Goodenough, & Karp, 1962), intellectual problem solving (Busse, 1968; Gardener, Jackson, & Messick, 1960; Karp, 1962), and memory investigations (Coward, & Lange, 1979; Frank, 1983). According to Reardon (1987) most studies dealing with field-dependence-independence employ embeddedness tests, which actually examine the restructuring component of the differentiation model.

Field Dependence and Field Independence (F-D-I) ~~*~~ ~~*~~

The F-D-I construct describes the ways people perceive and have knowledge of their environment. (A field independent cognitive style) is characterized by an articulated concept of the self. That is the part of psychological differentiation related to self-nonsel self segregation, wherein attributes, needs, and feelings are recognized as being one's own and distinct from others (Witkin & Goodenough, 1977; Witkin, Moore, Goodenough, & Cox, 1977). It is a pervasive characteristic, functioning across many situations, and is identified by self-consistency of behavior in perception and problem-solving (Witkin, et al., 1962; Witkin, Goodenough, & Oltman, 1979).

It is hypothesized that field independent (articulated) persons have (an analytical approach) to problem solving situations, (with the ability to overcome the influence of a competing or embedding context while recognizing relevant features) (Witkin, Moore, et al., 1977). (Field dependent) persons are without this innate ability to restructure and are often unable to overcome the most salient and obvious characteristics that may obscure the more important, relevant cues of the problem or situation. The field dependent's cognitive style is more global (i.e., less differentiated or articulated) in his approach to problem solving and acquiring information. He relies heavily on external referents, interpersonal cues, and dominant characteristics (Eagle, Goldberger, & Breitman, 1969; Sheriff, 1980) and develops skills along this pattern (Witkin, 1977).

The global-articulated continuum represents a person's ability to (overcome an embedding context.) "Articulated cognitive functioning" includes analysis and restructuring in perceptual and intellectual domains (Witkin, Moore, Goodenough and Cox, 1975). Persons functioning in a global cognitive mode (field dependent) experience difficulty in distinguishing figures from background in embeddedness tasks, due to a lack of restructuring ability, and rely more on social referents (Fitzgibbons, Goldberger, & Eagle,

1965) in exhibiting preference for stimuli. Where the individual relies on external referents, this should also influence the a development of restructuring skills (Witkin, Goodenough, & Oltman, 1979).

In the early development of the construct, Herman Witkin sought to explain why some persons perceived the upright using body referents, while others seemed to rely on visual referents. His research utilized a Body Adjustment Test (BAT), and later the Rod-and-Frame Test (RFT). In the BAT, the person is seated in a darkened room, in a chair which is adjustable with reference to the perpendicular. Persons who locate the upright position by body sensation are field independent. Those who use visual (external) referents are field dependent. The RFT uses a darkened room, a luminous frame and a movable luminous rod, which is tilted away from true perpendicular. The subject is asked to bring the rod to a position he perceives as upright. Again, field independents use body referents to solve the problem, while field dependent subjects are dependent on the visual field as a referent. Witkin and his associates subsequently developed the Embedded Figures Test (EFT), where the subject must be able to perceive the information (simple figure) independently from the competing field (larger complex figure). Witkin states that all

BAT

RFT

EFT

three tests (BAT, RFT, EFT) measure the ability to disembed from a complex context and are highly correlated to each other (Witkin et al, 1971). Subsequent study indicated that such tests assess the subject's ability for cognitive restructuring (Witkin & Goodenough, 1977).

F-D-I and Intellectual Functioning

The F-D-I construct has had broad investigation in the literature. Avolio, Alexander, Barrett, & Sterns, (1979) addressed field dependents' preference for a slower pace, while Jensen (1980) suggested that information processing speed was an indicator of general intelligence. Boysen and Thomas (1980) found a significant interaction between feedback and field dependence. Hedberg and McNamara (1985) affirmed the relationship of slower response time with field dependence. Lunneborg (1977) correlated motor and choice reaction time measures with performance on the Hidden Figures Test. Holley (1981) dealt with delayed testing effects. Robinson and Bennick (1978) investigated recall errors and response time. Checchini and Pizzamiglio (1975) investigated the development of field independence as a function of age and class status, but did not address the possibility of development or mobility beyond childhood years.

Concept Attainment and F-D-I

Concept learning requires analysis of a complex stimulus into attribute components (Dickstein, 1968). (Field dependent learners are dominated by salient cues, rather than relevant ones.) This is to say that field dependents seem to fix on the most obvious or prominent elements of a visual or verbal field, even when the obvious elements are not the factors most important to successful problem solving. An example might be where a background or contrasting pattern is the most prominent feature of a visual, while a lesser, more obscure, feature may be the most important to understanding and interpreting the visual stimulus. The field dependent fixes on the former, to the point of ignoring or overlooking the latter.

Field independent learners are not so dominated, and tend to sample more than field dependents, consequently learning more rapidly when salient cues are irrelevant (Eagle, Fitzgibbons & Goldberger, 1966; Goodenough, 1976; Nebelkopf & Dreyer, 1973; Shapson, 1973). Davis and Frank (1979) suggest that field dependents test fewer hypotheses, generate fewer combinations, recall fewer cues, and fail to recall extracted information. Witkin cites Wordsworth's observation that field dependents are more passive than the more participatory field independent learners (Witkin, et

al., 1977). The use of cues or prompts may aid in disembedding the stimulus into its component parts, allowing more consistent focus on the relevant features of the problem (Shapson, 1977) among both field dependents and field independents (Davis & Klausmeier, 1970; Reinking, Goldstein, & Houston, 1974).

~~etc~~
cues

Memory and F-D-I

It has been hypothesized that differences in working memory explain differences in field-dependence-independence (Case, 1974) in studies of information load (Bennick & Spoelstra, 1979) and of task difficulty (Dargel & Kirk, 1971). Frank (1983) observed significant cognitive style, recall and cognitive style by recall effects in an experiment with paired, cued recall. The indication is that this is due either to shallow information processing or less efficient strategies related to cognitive restructuring.

Metacognition

Metacognition is the knowledge that individuals have about the functioning of their own cognitive processes (Lovelace, 1984). The metacognitive strategies used in the studies cited here are more related to providing a process-

ing structure than to restructuring specific cognitive stimulus. Metacognition is called "the feeling of knowing in memory and problem solving" by Metcalfe (1968). It is more specifically described as the structure within which cognitive experiences occur (Beuring, 1987). Strategies that add structure to cognitive tasks are of central interest to this study. Several studies have involved training learners in metacognitive strategies for increased performance, including expository writing (Holmes, 1986); elaborations (Burgadeen, 1986); monitoring future recallability (Lovelace, 1984); direct instruction in text structure (Hickerson, 1986); and associative memory (Beuring, 1987).

Restructuring

The tendency to rely on internal frames of reference, or field independence, is characterized by greater cognitive restructuring ability. The internal frame of reference provides a mediating mechanism for the individual in restructuring tasks, enabling the field independent person to go beyond the given information.

The field dependent's disadvantage related to restructuring is due to less efficient selection of appropriate strategies for problem solving (Pascal-Leone, Ammon, Good-

man, & Subleman, 1978). It is documented in several studies that there is little difference in the general ability to learn between perceptual types (Goodenough, 1976; Satterly, 1976).

In the Witkin, et al., (1977), literature review, as in Goodenough's (1976) review, the construct is described as value neutral, with a discussion of the adaptive utility of each style. Other researchers disagree, pointing to memory efficiency and analysis superiority among field independents (Davis & Frank, 1979). It is possible that memory differences among field dependents are the result of poor structuring at acquisition, inhibiting recall of what Witkin called "intrinsically unorganized material" (Witkin, et al., 1962, p. 99). These differences are only apparent when information load is high (Robinson & Bennick, 1978).

According to Witkin and Goodenough (1981), under ambiguous situation the field dependent person will make up for the difficulties in restructuring by using information from others as aids. These tendencies will be reflected in interpersonal orientation and cognitive restructuring skill (Witkin, 1977). The reviewed research indicates that the ability to restructure information in a perceptual and cognitive mode involves three components: (1) breaking down a complex stimulus into elements, (2) providing struc-

→
cue

→

ture for an ambiguous complex stimulus, (3) providing a different structure from that inherent or salient in the complex stimulus. Restructuring ability is traditionally measured by embeddedness tests, but other tasks requiring restructuring include verbal disambiguation and perspectivism. In each case, the field dependent person is more likely to adhere to the perceived stimulus structure (Witkin & Goodenough, 1981).

44
EFT

Embeddedness

Witkin (1950) correlated performance on the Body Adjustment Test and the Rod and Frame Test with disembedding ability. He found that the ability to disembed a simple figure from a complex field was significantly related to perception of the upright. In 1977, Witkin and Goodenough responded to the seemingly contradictory findings occurring when the RFT and the Embedded Figures Test (EFT) were used interchangeably (Linn, 1980). They concluded that the processes involved in the two tests were related but distinct (not interchangeable) from one another and that an embedded figure problem was an "exemplar of a cognitive restructuring task" (Witkin & Goodenough, 1977, p. 5).

Perspectivism

Perspective tasks, also called reversal tasks, require perception of a stimulus from a new perspective. Reversible perspective tasks are related to perceptual tasks such as disembedding (Gardner, 1961; Newbegg, 1954). Newbegg found a relationship between restructuring and perception of relevant lines in different relations to one another. Supporting his hypothesis was the correlation between embeddedness tasks and perspectivism tasks.

In related studies, perspective reversals, embedded figures, and perception of the upright tasks were found to be correlated to field-dependence-independence (Haronian & Sugerman, 1966). The ability to resist perceptual fluctuations was perceived as independence from, or resistance to, the social field (Jackson, 1958; 1959) thus relating perspectivism to field-dependence-independence. Messick and French (1975) used these findings to help confirm self consistency of the F-D-I construct related to spatial restructuring.

Verbal Disambiguation

There is a developing but somewhat lacking body of research dealing with verbal ability and cognitive restructuring (Witkin & Goodenough, 1981). Research has shown

relationships between vocabulary and performance on the Embedded Figures Test (Goodenough & Karp, 1961). There have also been empirical links made between cognitive restructuring and the reorganization of ambiguous verbal materials (Goodman, cited in Witkin, et al., 1962; Kleine, 1967; Statz, 1974), new organization to an inherently organized field (Noble, 1984), and field-dependence-independence and free verbal recall (Fleming, 1968). Messick and French (1975) identified verbal disambiguation (problem solving) as flexibility of verbal closure (Noble, 1984).

Restructuring Training

Restructuring training experiments in children demonstrate that change in perceptual type is related to the developmental process (Witkin, Goodenough, & Karp, 1967). Some studies have indicated success in developing greater field independence among children previously tested as field dependent via training (Elkind & Deblinger, 1969; Egeland, 1974).

Bien (1974) found that field independent children set up and solve more mathematics word problems than field dependent, but do not differ in arithmetic computational skills. When word problems were presented with a provided

structure that Bien called "cognitive-perceptual structure," no statistically significant difference in performance was observed. In fact, it was found that after field dependent students had used this strategy to solve a set of word problems, they were able to correctly solve the unstructured problem. This seems to suggest a transfer effect of the restructuring strategy learned where such a structure did not previously exist. Subsequently, field dependent students were able to solve problems as they were normally presented (Vaiyda, 1981).

Researchers have suggested that the strategies which arise from cognitive styles may be somewhat more malleable than the styles themselves. For example, a field dependent will adopt a hypothesis-testing approach when the instructional situation is set up to elicit such a response, although he or she normally takes a more intuitive route to concept attainment (Reardon, 1987).

Witkin (1950) noted that many field dependents had to trace lines with their finger or pencil when attempting to solve visual disembedding tasks. Conklin, Muir, and Boersma (1968) hypothesized that these tracing movements corresponded to eye movements and that those with active eye tracing movements should solve analytic visual tasks faster. Their finding was that longer, more random eye move-

ments were used by field independents. field dependents often became fixated on salient aspects of the visual, and exhibited less organization, more erratic movements, and more blinking behavior under stress (Britain, 1969). The 1969 study of Boersma, Muir, Wilton, and Barham found that field independent individuals initially spent less time examining specific letters of anagrams in a disambiguation task, but made more eye movement shifts during solution. Some related studies outside the F-D-I construct indicate that "active perceptual scanning" leads to successful analysis and solution on many visual tasks, including revolving pointer detection (Mackworth, Kaplan, & Metlay, 1964); image detection (Luborsky, Blinder, & Mackworth, 1964); anagrams (Kaplan & Schoenfield, 1966) and memory sequencing (Britain & Wolff, 1979).

Zelniker, Jeffrey, and Ault (1972) found training in search strategies to improve scanning in children. Britain (1979) cites studies by Henry (1973), Siegal and Cara (1971), and Egeland (1974) as having found differential effects of reinforcement strategies, concluding that "perceptual behavior was modifiable". This agreed with O'Bryan and Boersma (1971) who argued that training of decentering eye movement patterns would accelerate cognitive development. Britain further stated that "perceptual training, easily accomplished in a classroom situation,

could enhance the performance of field dependent children on tests of analytic function." Lawson and Wollman (1976) addressed the question of whether such training would transfer to tasks beyond the training tasks to new tasks. They found, as did Bredderman (1973), that some students made little progress. Strawitz (1984) explained this difference in terms of cognitive style, and found that a training sequence that was designed to teach subjects to "resist misleading perceptual cues" (patterned after a study by Case (1975)) was successful with both the treatment group and with field-independent subjects in the control group. Strawitz notes that of particular importance is that field dependent children who were initially unable to control variables were "successfully taught to control variables and to retain and transfer this ability four weeks after instruction. Furthermore, the time required for training was very short". Restructuring training among adults on embeddedness tasks is relatively unexplored.

SUMMARY

④ (Field-dependence-independence is a construct of psychological differentiation theory that identifies individual differences in terms of autonomy of external referents, or

self-non-self segregation.) Field dependents are hypothesized to rely on external referents. field independents have access to cognitive restructuring skills, allowing them to solve disembedding or disambiguating tasks with greater ease and accuracy than field dependents. Perceptual type predisposes field independents to employ cognitive strategies to differentiate a complex stimulus. Although no superiority of intellectual ability is ascribed to either the field dependent or field independent cognitive style, it is noted that field independents seem to enjoy more flexibility in utilizing problem solving strategies due to their perceptual type.

Restructuring strategies employed by field independents seem to be related to a developmental aspect of cognitive functioning. Some research has indicated movement in manifestation of cognitive style after perceptual training in restructuring strategies, although most research has been done with children.

Based upon the review of literature, the following hypotheses were developed:

1. Field independent subjects will perform significantly better than field dependents on complex restructuring tasks.

2. Field dependent subjects receiving training and practice in restructuring strategies will score higher on subsequent restructuring tasks than subjects receiving no training or practice.

3. There will be significant interaction between group (control and training) and F-D-I category (levels of field-dependence-independence).

CHAPTER III

RESEARCH METHODOLOGY

This chapter outlines the methods and procedures utilized in this study, as well as stating the research hypotheses. The following section will discuss: (a) research design, (b) the rationale for experimental tasks, (c) pilot study, (d) selection of subjects, (e) instrumentation, and (f) description of procedure.

The study was designed to identify restructuring strategies inherently used by the field independent perceptual type and teach these strategies to field dependents. Subsequent to this training, all participants were given tasks requiring use of restructuring strategies to see if gain occurred. These activities would be analyzed for significant multivariate relationships between the learning of restructuring strategies and actual performance on tasks requiring restructuring. The study was to also determine the extent of differences between levels of field-dependence-independence and the presence or absence of restructuring strategy training.

The rights of each subject were recognized throughout

the study. Permission for the study to be conducted at Virginia Highlands Community College was secured through the office of the Dean of Instruction and Student Affairs. Written consent was secured from from each subject prior to the examination procedure. All subjects were told that they would take part in a study examining cognitive style and restructuring ability and that no personal risk would be involved, that they were free not to participate, and that the data would be used as grouped data. Confidentiality was assured by the researcher. A personal data form asked each participant for age, sex, and social security number.

Research Design

A posttest only control group 2 x 3 research design (group x level of F-D-I) was used, analyzing data using a two-way multivariate analysis of variance (MANOVA). This statistical approach allows for "reasonable departures from normality and homogeneity without seriously influencing the validity of inferences drawn from the data" (Ferguson, 1981). The multivariate analysis was followed by post hoc (Newman-Keuls) multiple comparison tests where significant effects were indicated by the univariate ANOVA. The level of statistical significance for all procedures used in this

study was set at $p \leq .05$. The posttest only research design, through random assignment, controls "selection, history, maturation, and statistical regression" (Huck, Cormier, & Bounds, 1974). Also, since the subjects aren't measured before the posttests, the threats of instrumentation and testing do not exist. In terms of internal validity, this design is potentially most threatened by mortality. In the present study, however, mortality was not a problem, with 115 of 117 students persisting through the study. Cognitive style (field dependent, field independent) and training in restructuring strategies (training, no training) were the independent variables. The dependent variables were type of restructuring task (disembedding, perspectivism, and verbal disambiguating.) Graphically, the research design is represented by Figure 1, repeated for each dependent variable.

2 x 3 FOR EACH DEPENDENT VARIABLE

GROUP 1 (CONTROL)			
GROUP 2 (EXPERIMENTAL)			
	FD	FN	FI

LEVEL OF FIELD-DEPENDENCE-INDEPENDENCE
FIGURE 1. Research Design

Rationale for Experimental Tasks

When Witkin and Goodenough (1981) identified the components of restructuring ability, it became apparent that restructuring elements may occur when field independent persons attempted to process stimuli in tasks other than those solely of embeddedness. They hypothesized that both verbal disambiguation and visual perspectivism would also require use of restructuring strategies. Thus, the study at hand identified such tasks and has used them as post-tests following the instructional or training session.

Pilot Study

A preliminary study was undertaken to establish thresholds for training time and to execute a trial run of the logistical plan for posttesting. The study was carried out with 36 students, 22 of them work/study students in the Academic Support Services department and 14 students from an English composition class at VHCC. The students were told that they were participating in a pilot study and would be individually interviewed in addition to a group survey given them after testing. Feedback from the group affirmed that both the training and the testing were acceptable in terms of time.

All participants were asked to describe their solution strategies for each type of restructuring task they performed. This allowed students to articulate their strategies as a safeguard against use of unexpected or unknown restructuring strategies. It was found, however, that the restructuring strategies implemented by the group were already represented in the training materials. The student handout (Appendix B) is a listing of the restructuring strategies used in the training lectures.

Participants asked that the training contain more demonstrated examples of applying restructuring strategies. This was not unexpected, since this essentially constituted a request for more specific structure from field dependent respondents. Test tasks known to have a component of restructuring were selected for use in demonstration and practice of use of restructuring strategies. These test tasks are identified in Appendix C.

Class periods dictated the time parameters, so that there were two 75-minute sessions. Since the posttesting took approximately 35 minutes, it was decided to use the first 30 minutes of the second day session for more review of restructuring strategies from the previous session's training activity. To better use the time, the Hidden Figures Test (HFT) would henceforth be used as the F-D-I

identifier, with the Group Embedded Figures Test (GEFT) as the posttest for embeddedness.

Analysis of pilot study data was not attempted, but all data was reviewed and compared with survey information and interview responses. There seemed to be enough score range on both the GEFT and the posttests to provide variance. Reliability for all tests was stipulated to be as the test publishers state in the test manuals. The survey indicated participant satisfaction with the procedures, the training lesson, and the testing portion of the experiment. The mean satisfaction rating was 1.48 on a 1-5 scale (1 = very satisfied, 5 = dissatisfied).

Since verbal ability had been mentioned in the literature as possibly accounting for performance differences among field dependents and field independents, the Advanced Vocabulary Test II (French, Ekstrom, & Price, 1963) was administered. Results of the test were not significantly related to the HFT scores ($r = .180$) so verbal ability was dropped as a variable. When considered as a covariate to the HFT, vocabulary performance was not significant ($B = -.65$, $Beta = -.196$, $t = 1.73$ $p > .05$).

Subjects

The participants in this study were selected from students enrolled in introductory psychology courses at

Virginia Highlands Community College. Participation was voluntary. The Hidden Figures Test was administered to establish predominance toward field dependence or field independence. For the purpose of this study, a score of 10 or below was designated as field dependent, while a score of 16 or above denoted field independence. Scores in the 11-15 range were labeled F-D-I neutral. This study used a procedure employed in many studies (Noble, 1974; Reardon, 1987) where the bottom 40% of the scale of observed scores are designated field dependent. Scores in the middle 20% are described as F-D-I neutral, while scores in the upper 40% were designated field independent. Percentages were calculated on the actual observed range of scores, which for this study was 1 to 25.

Students were notified of the time requirements and location of the experiment, and were assured of the confidentiality of results. The sample size was expected to be between 100 and 140. One hundred fifteen students actually began and completed all portions of the pretest and post-tests.

Instrumentation

HFT (Hidden Figures Test)

The Hidden Figures Test (cf-1) was used as the measure of field-dependence-independence. It is an adaptation (Ek

strom, French, Harman, & Dermen, 1976) of the Gottschaldt Figures type test made popular by Thurstone. This particular form of the test was modified from a 1963 instrument designed to investigate field dependence. The test involves the ability to locate one of five simple figures embedded in a more complex design. The test is composed of two parts with 16 questions for each part. It is multiple choice in format. It is five pages in length, with one page of instructions and four pages of test items. To receive credit for an item, subjects must study the complex pattern, find the simple pattern embedded within, and indicate the letter which corresponds with the correct simple figure at the top of the problem. There is only one correct solution, always positioned and sized identically to the simple figure in the choices.

The examiner scores each test individually by comparison with the key, with a fractional penalty for incorrect responses. Subjects are given 12 minutes for each of the 16 item sections. Scores may range from zero to 32.

The manual provides norms based on data from the 1963 HFT. The 1976 test is a revision of the earlier instrument with reliability estimates listed as .81 for males (n=288) and .80 (n=317) for females among a sample selected from suburban 11th and 12th graders. A university population of

males provided an estimated reliability for the HFT of .83. Correlations between the HFT and the Embedded Figures Test of .84 (males, n=52) and .62 (females, n=60) were reported by Jackson, Messick, & Myers (1964).

GEFT (Group Embedded Figures Test)

The Group Embedded Figures Test (GEFT) was used as the posttest measure for classifying participants' disembedding ability. The GEFT is an adaptation of the Embedded Figures Test (EFT), an individually administered test of disembedding ability (Witkin, Oltman, Raskin, & Karp, 1971). The GEFT requires subjects to find a simple geometric design or figure that is embedded within a more complex figure. There are 25 such figures in the GEFT, 17 of which were taken from the EFT. There are three sections of 7, 9, and 9 items, which have respective time limits of 2, 5, and 5 minutes. The first seven items are practice items, and are not scored. Thus the score can range from zero to 18, depending on the number of correctly traced figures. The tests are individually scored by the examiner, and each item must be completely traced and correctly sized and oriented relative to the sample figures. Normative data for performance, reliability and validity are provided in the manual.

Paper Folding (VZ-2)

Suggested by Thurstone's Punched Holes, the Paper Folding Test (VZ-2) is a test requiring use of visualization as well as spatial orientation.

For each item of the test, successive drawings illustrate folds made in a square sheet of paper. The final illustration shows where a hole is punched in the paper. Five choices are given from which the subject selects the illustration that shows how the punched sheet would appear if fully unfolded.

The primary factor involved in solution of this type of problem, visualization, requires mental restructuring into components while the whole figure is manipulated in spatial orientation (Harmon, French, Ekstrom, & Dermen, 1976).

Tasks such as these involve restructuring of the visual perspective in that "flexibility, or readiness to change a perceived visual figure, helps to correct errors in visual perception" (Guilford, 1981). The Paper Folding Test consists of two three minute parts, with 10 items in each part.

Scrambled Words (CV2)

The Scrambled Words Test (Ekstrom, French, & Harman, 1976) is a test of verbal closure presenting a five-letter nonword anagram whose unscrambling produces only one correct five-letter word. The words are varying in degree of difficulty.

Students are given an anagram and are asked to recombine the letters into a word. The degree to which they are able to successfully overcome the given context and to employ successful solution strategies indicates the ability to restructure in an ambiguous verbal context. The Scrambled Words test is part of the Educational Testing Services (ETS) Kit of Factor-Referenced Cognitive Tests which contains 72 norm-referenced tests demonstrated to be consistent markers for 23 cognitive factors.

Description of the Experimental Procedure

The experimental treatment involved testing all students for F-D-I type, then presenting one group of students with a lesson in restructuring strategies. The other group of students received no such instruction or training in restructuring strategies. Both groups completed a subsequent series of test tasks known to require employment of restructuring strategies for solution. Scores on these tasks were

compared for field dependents and field independents, and compared for those receiving restructuring training and those receiving none. Interactions for between and within factors were also investigated.

The experiment took place over two non-consecutive days, within a normal 75 minute class period for each of the two sessions. The first session consisted of the administering of the HFT, and for the treatment group a subsequent discussion on the restructuring strategies employed in successful solution of the test items. One-half of the students were randomly pre-selected to be excused immediately after testing, and were dismissed on the pretext that class-halves would alternate work on an independent study project in the library.

The experiment lesson followed the lecture outline (Appendix B), incorporating selected practice exercises after a general description of restructuring in the presence of competing stimuli. Examples were introduced and students completed sample problems in finding hidden patterns, completing incomplete words, finding differences in figures, finding a path through a maze, and visualizing how an object could be formed by folding a piece of paper. As these activities were conducted, the experimenter suggested strategies, including eye movement strategies and the

interrupt function when unsuccessful strategies were employed. The students were also encouraged to refer to the handout for selection of an appropriate strategy. At the end of the first treatment period, a brief summary reiterated the description of restructuring and strategies appropriate to problem solving using these strategies. All materials were collected at the end of the training session.

The second treatment period (two days later) consisted of a brief review of the first lecture, followed by practice in restructuring, with instructions and suggestions for employing appropriate strategies. The practice activities included copying a pattern, finding hidden words, comparing cubes, and completing a figure from given pieces.

The practice materials were all from the "Kit of Factor Referenced Cognitive Tests" from Educational Testing Service (with permission). The tests are norm-referenced and demonstrated to be consistent markers for certain cognitive factors. A listing of the tests used as practice activities, along with an annotation as to the factors examined by the tests are included as Appendix C.

Students selected to receive restructuring training received approximately 45 minutes the first day, and 30 minutes the second day. All students completed the F-D-I marker test (HFT) and the posttests (GEFT, Paper Fold Test

VZ-2, Scrambled Words Test CV-2). Materials were divided to best accommodate these time constraints. On the second day of training, control group students reported to class 30 minutes later than usual for a scheduled test, which would be posttesting. All students had the same amount of time to complete the posttests, and each had the expectation of taking a test at this time.

Chapter IV

DATA ANALYSIS AND RESULTS

The data analysis portion of this study will present as its primary procedure a 2 x 3 multivariate analysis of variance (MANOVA). The least squares regression approach was employed, a recommended procedure when cell sizes are unequal and disproportionate. The routine descriptive data is presented first, identifying dependent and independent variables for the analysis. Alpha was set at $p < .05$ for all statistical tests in this study. Cell sizes, means and standard deviations are described by tables and narrative for interaction, treatment (group) and F-D-I effect. Correlation coefficients describe the relationship of the dependent variables to one another. Wilks' Lambda values were used to test the multivariate null hypothesis after the assumption of homogeneity of regression was rejected on the basis of observed univariate significance. The Newman-Keuls provided follow-up to the test of the multivariate null, and was used to separate and estimate the relationship between all pairs of means. ANOVA tables for each dependent variable show univariate main effects and interaction and are followed by the plotting of cell means to

graphically illustrate interactions on each dependent variable.

This chapter presents the results of a study undertaken to determine the relative effectiveness of restructuring training on a population of learners classified on the field-dependence/field-independence dimension of cognitive style. The design was posttest only control group design, which controls for most threats to internal validity. Effectiveness of training was measured by the three following dependent measures:

1. An embeddedness task, tested by the Group Embedded Figures Test (GEFT).
2. A verbal disambiguating test, the Scrambled Words Test.
3. A task of visual perspectivism, the Paper Folding Test.

Each task is considered to require employment of restructuring strategies for solution (Witkin & Goodenough, 1981).

A multivariate analysis of variance (MANOVA) was undertaken to allow evaluation of mean differences of the three dependent variables simultaneously. MANOVA was chosen to reduce the probability of making a type 1 error and to control the overall alpha level for this study at .05. Also, MANOVA allows exploration of relationships among the variables. The dependent variables were scores on GEFT,

Scrambled Words Test, and Paper Folding Test. The independent variables were group (training or control) and level of field-dependence independence (F-D-I). One hundred fifteen participants completed the experiment. Participants were randomly assigned to either the training group or control group, and were given a Hidden Figures Test (HFT) to determine level of field-dependence-independence. Scores ranged from 1 to 25. Initial analysis of variance used the score on the HFT as a continuous variable. Effect was shown for Group x HFT on two of three dependent variables; GEFT-- $F(1,111)=17.35$, $p<.01$; Scrambled Words Test-- $F(1,111)=16.45$, $p<.01$; Paper Fold Test -- $F(1,111)=7.20$, $p<.84$. This univariate violation of the assumption of homogeneity of regression was the basis to consider the multivariate effects. The HFT scores were then classified into categorical levels for follow-up to MANOVA, a process that would allow examination of the main effects and interaction. It is important to note that all statistical operations were based on the null, although the research hypotheses were stated directionally.

To establish HFT score as a categorical variable, score ranges were established to represent three levels of field-dependence-independence. Scores were determined to indicate a predisposition towards field dependence marked at or below the fortieth percentile of the observed scale of

scores. The middle twenty percentiles of the observed scores were regarded as F-D-I neutral, neither predominantly field dependent nor field independent. Scores in the highest forty percent of the observed score range were classified as field independent. In terms of raw scores, a score of 1 to 10 made up the field dependent level, from 11 to 15 a neutral range, and from 16 up, the field independent level. This methodology was suggested by several studies, preeminently the Reardon (1987) map learning study and the verbal restructuring study done by Noble (1984). Using this method, there were 60 field dependents (expected in a community college sample), 28 who showed no predominance for either field dependence or field independence, and 27 field independents. The mean score for all subjects on the HFT was 10.99. Field dependents represented 52.2% of the sample. The neutral range accounted for 24.3% of the sample, and 23.5% scored in the range indicating field dependence. Fifty-six (56) participants were randomly assigned to the experimental group by drawing, with 59 assigned to the control group, for a total of 115 participants. Frequency distributions for the dependent scores are included in Table 1, along with cell means and standard

deviations, which are provided for the independent variables by each dependent variable from the analysis of data (Tables 2,3,4). Mean score for dependent variable GEFT was 11.09; for Scrambled Word Test, 41.71; for Paper Fold Test, 9.90.

TABLE 1

Score Frequencies on Dependent Variables

GEFT	SCRAMBLED WORDS	PAPER-FOLD
SCORE-FREQUENCY	SCORE-FREQUENCY	SCORE-FREQUENCY
1-1	20-1 43-4	3-5
2-1	23-1 44-6	4-5
4-5	25-1 45-6	5-4
5-6	28-2 46-7	6-8
6-6	29-3 47-11	7-7
7-9	30-1 48-5	8-8
8-6	32-1 49-8	9-17
9-11	33-2 50-11	10-15
10-6	34-3	11-8
11-7	35-3	12-6
12-5	36-7	13-11
13-14	37-3	14-10
14-6	38-1	15-3
15-12	39-9	16-6
16-10	40-9	17-1
17-7	41-8	19-1
18-3	42-2	

Table 2

Cell Means and Standard Deviations of Independent Variables Group and F-D-I (for Dependent Variable GEFT)

Factor	Mean	Std. Dev.	N
Control Group			
FD	6.41	2.51	29
FI	15.47	1.77	19
FDI-Neutral	11.82	2.14	11
Experimental Group			
FD	10.68	3.45	31
FI	15.60	1.35	10
FDI-Neutral	11.93	2.92	15
For Entire Sample	11.10	4.18	115

Table 3

Cell Means and Standard Deviations of Independent Variables Group and F-D-I (for Dependent Variable Scrambled Words Test)

Factor	Mean	Std. Dev.	N
Control Group			
FD	35.17	6.32	29
FI	45.53	4.71	19
FDI-Neutral	43.46	2.51	11
Experimental Group			
FD	43.29	5.32	31
FI	43.20	7.33	10
FDI-Neutral	44.00	4.94	15
For entire sample	41.71	6.61	115

Table 4

Cell Means and Standard Deviations of Independent Variables Group and F-D-I (for Dependent Variable Paperfold Test)

Factor	Mean	Std. Dev.	N
Control Group			
FD	7.31	3.34	29
FI	13.68	2.93	19
FDI-Neutral	9.64	1.29	11
Experimental Group			
FD	9.19	3.09	31
FI	11.70	2.50	10
FDI-Neutral	10.67	3.11	15
For entire sample	9.91	3.61	115

Correlation coefficients in Table 5 show low correlation between test tasks (dependent variables).

Partial Correlations from the SS Matrix / prob > [R]			
DF=111	GEFT	SCMWORD	PAPFOLD
GEFT	1.00 0.00	0.28 0.003	0.31 0.001
SCMWORD	0.28 0.003	1.00 0.00	0.23 0.02
PAPFOLD	0.31 0.001	0.23 0.02	1.00 0.00

Multivariate Analysis of Variance (MANOVA)

Wilks' Lambda was used to test the multivariate null hypothesis. The Wilks' Lambda is the oldest and most frequently used procedure for testing the multivariate null (Huck, Cormier, & Bounds, 1974). Based on the results the researcher rejected the assumption of homogeneity of regression that hypothesizes no overall effect for Group, F-D-I, or Group by F-D-I. The following represents the MANOVA test for the hypothesis of no overall effect:

For no overall Field-Dependence-Independence Effect
 Wilks Criterion-Lambda = .44
 (F = 18.03 df = 6,214 p<.01)

For no overall Treatment Group Effect
 Wilks Criterion-Lambda = .79
 (F = 3.05 df = 3,107 p<.05)

For no overall F-D-I by Treatment Group Effect
 Wilks Criterion-Lambda = .77
 (F = 5.05, df = 6,214 p<.01)

On the basis of the observed MANOVA F values at $p<.01$, the assumption of homogeneity was rejected, and significant effects were found for field-dependence-independence, treatment group, and F-D-I by group interaction. The conclusion drawn was that there is difference in the groups of means (vectors) that cannot be attributed to random sampling fluctuations.

Through MANOVA, mean differences on all dependent variables were evaluated simultaneously, while controlling for intercorrelations among them. After the multivariate is considered, Hummel and Sligo (1971) recommend using ANOVA to consider the univariate effects and interaction, where significance is apparent. This method, often referred to as Least Significant Difference (LSD), proposes that the overall multivariate tests provide protection from type I error on the p univariate tests.

ANOVA tables for each dependent variable follow, and are labeled Tables 6, 7, and 8. Type III sums of squares are used because of the unbalanced design (unequal observations in each cell).

Table 6

Summary of Analysis of Variance: Dependent VariableGEFT

SOURCE	DF	SS	MS	F VALUE
MODEL	5	1206.97	241.39	33.35
ERROR	109	788.98	7.24	
CORRECTED TOTAL	114	1995.95		0.0001

SOURCE	DF	TYPE III SS	F VALUE	PR > F
FDI	2	898.23	62.05	0.0001
GROUP	1	52.73	7.29	0.0081
GROUP*FDI	2	120.01	8.29	0.0004

Table 7

Summary of Analysis of Variance: Dependent Variable
Scrambled Words Test

SOURCE	DF	SS	MS	F VALUE
MODEL	5	1728.71	345.74	11.59
ERROR	109	3252.82	29.84	PR > F
CORRECTED TOTAL	114	4981.53		0.0001

SOURCE	DF	TYPE III SS	F VALUE	PR > F
FDI	2	641.37	10.75	0.0001
GROUP	1	96.24	3.23	0.0753
GROUP*FDI	2	596.82	10.00	0.0001

Table 8

Summary of Analysis of Variance: Dependent Variable
Paperfold Test

SOURCE	DF	SS	MS	F VALUE
MODEL	5	497.62	99.52	11.09
ERROR	109	978.32	8.98	PR > F
CORRECTED TOTAL	114	1475.95		0.0001

SOURCE	DF	TYPE III SS	F VALUE	PR > F
FDI	2	345.41	19.24	0.0001
GROUP	1	1.25	0.14	0.7096
GROUP*FDI	2	62.78	3.50	0.0337

On the dependent variables GEFT, Paper Fold Test, and Scrambled Word Test, the observed univariate F is significant for field-dependence-independence (GEFT $F(2,109)=62.05$, $p<.01$; Scrambled Word $F(2,109)=10.75$, $p<.01$; Paper Fold $F(2,109)=19.24$, $p<.01$). The Group variable was significant only for the GEFT -- $F(1,109)=7.29$, $p<.05$. For the interaction of F-D-I by Group, all three dependent variables (GEFT -- $F(2,109)=8.29$, $p<.05$; Scrambled Words -- $F(2,109)=10$, $p<.01$; Paper Fold -- $F(2,109)=3.50$, $p<.05$) show effect at a significant level. A plot of the interactions (Figures 2, 3, 4) to graphically represent the main effects was done separately using cell means for each of the dependent variables. A disordinal interaction was illustrated for the experimental and control groups of field dependent means on the GEFT, the Scrambled Words Test, and the Paper Fold Test.

Post Hoc Multiple Comparisons

It was decided to further analyze the interactions for group by F-D-I on each dependent variable using the Newman-Keuls as the post hoc multiple-test procedure. Newman-Keuls is a powerful but conservative way to specify where the significant differences in posttest means might occur (Huck, Cormier, & Bounds, 1974). Tables comparing observed

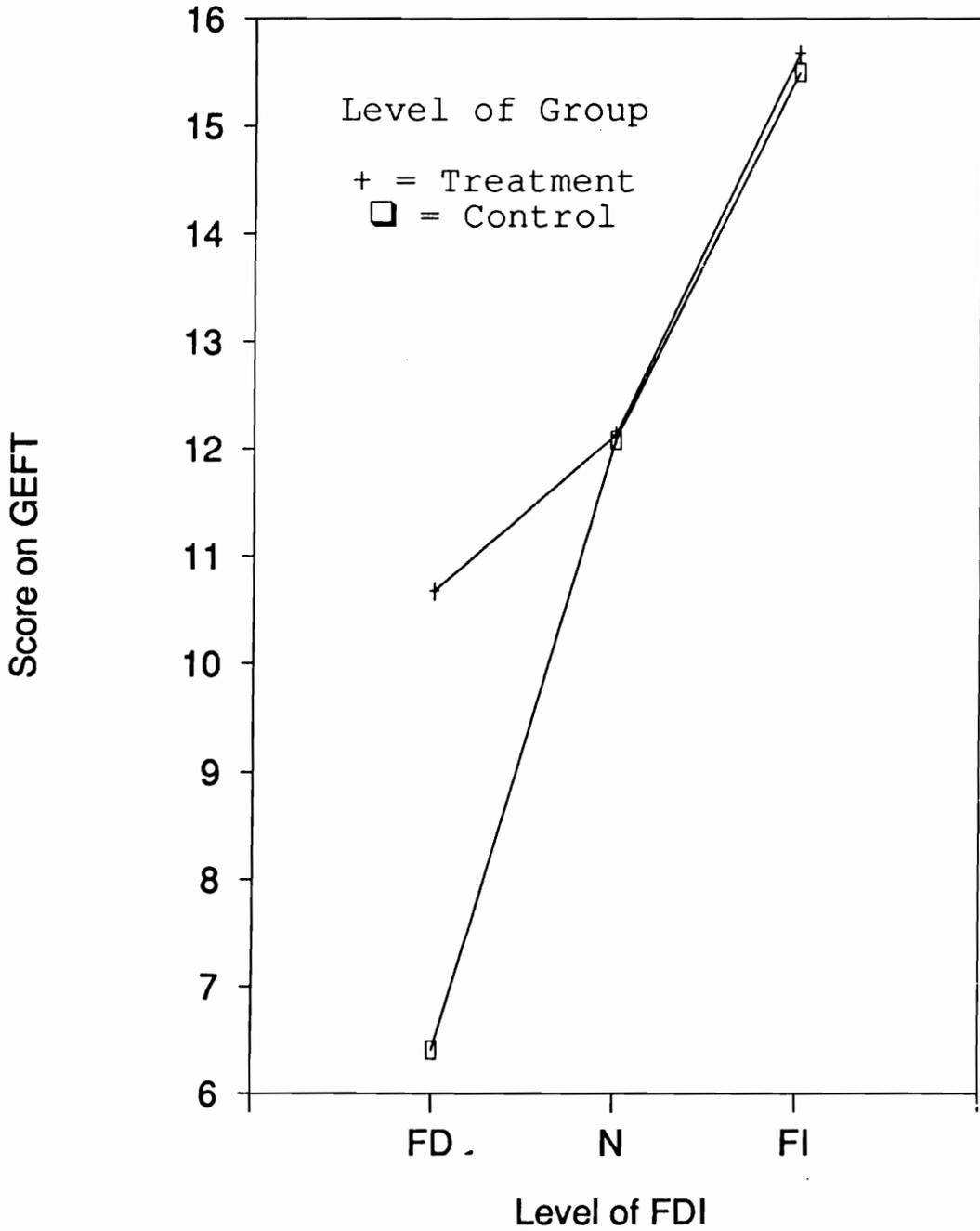


Figure 2. Interaction of Group x FDI for
 Dependent Variable Group Embedded Figures
 Test

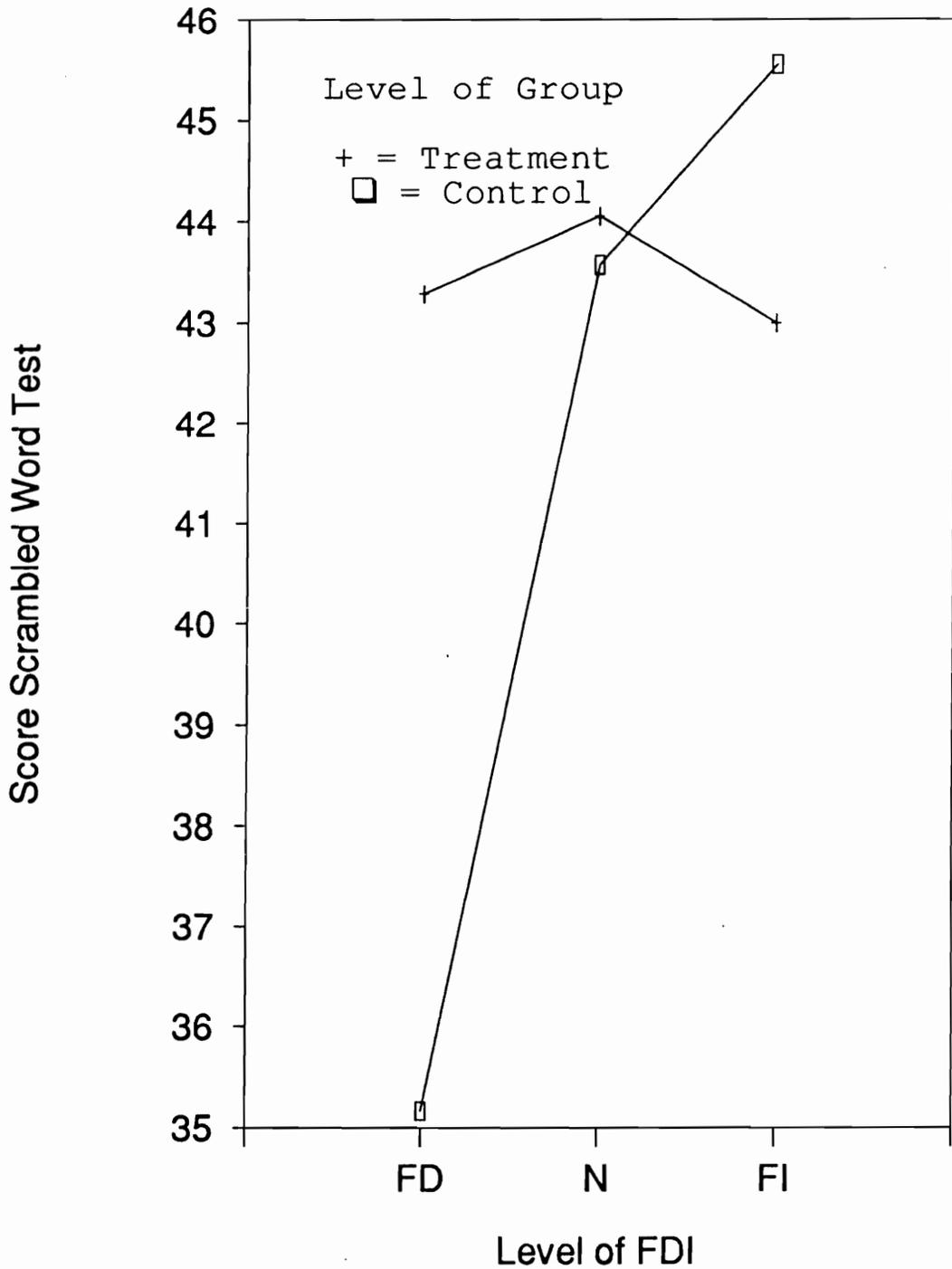


Figure 3. Interaction of Group x FDI for Dependent Variable Scrambled Words Test

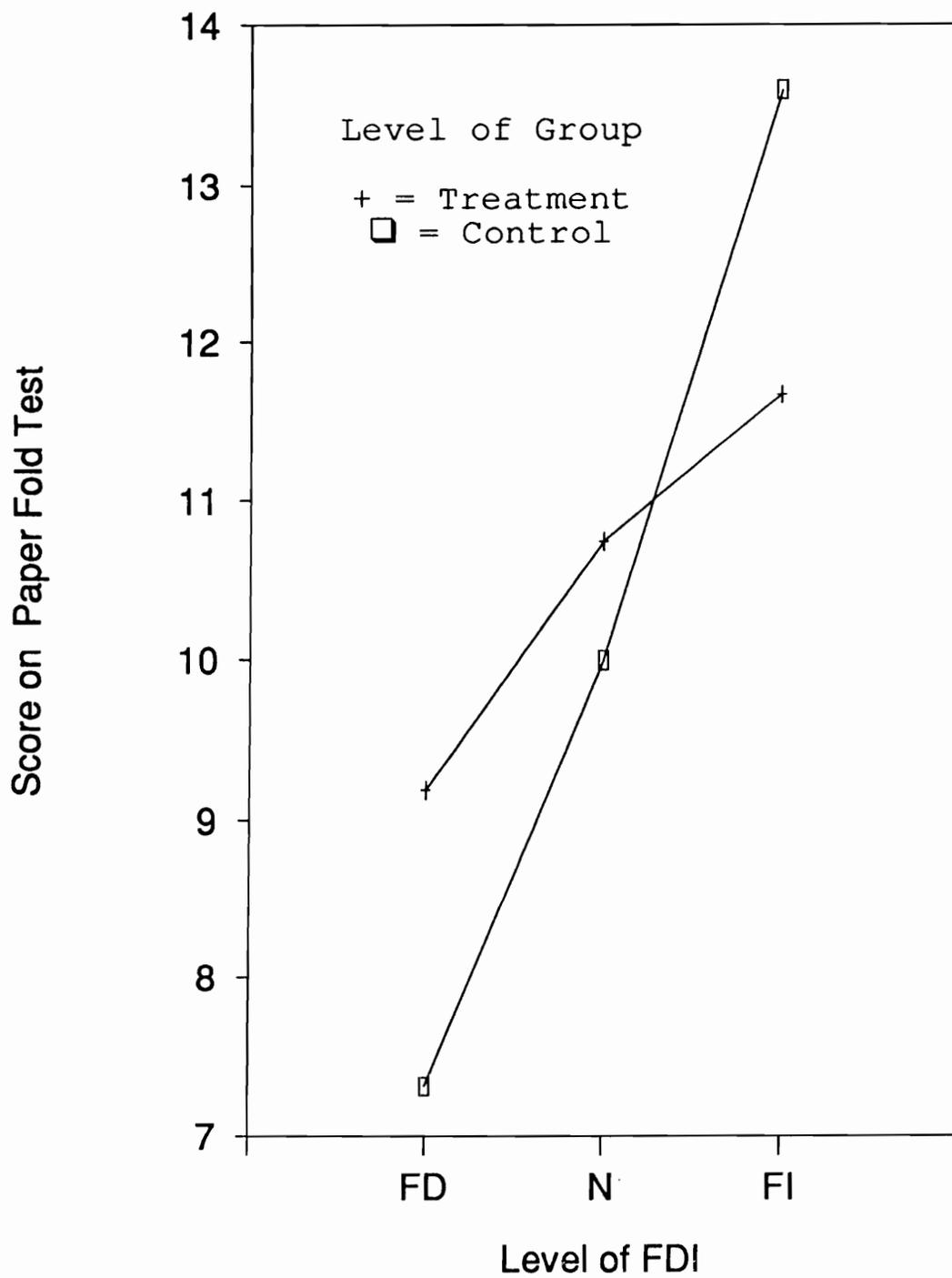


Figure 4. Interaction for Group x FDI for Dependent Variable Paper Fold Test

Q-values to critical Q-values (denoting significant differences) are presented for each dependent variable, and are labeled Tables 9, 10, and 11. Results are presented in triangular table form. The following pairs were observed to be significantly different:

For GEFT - All means differed from field dependent (control); field independents (control and experimental) differed from field dependent (experimental); field independents (control and experimental) differed from F-D-I neutral (experimental and control) (See Table 9).

For Scrambled Word Test - all means differed from the field dependent control group. No other significant differences were noted (See Table 10).

For Paper Fold Test - Field dependent (control) mean differed significantly from field independent (control) and from field independent and F-D-I neutral (experimental). Field independent (control) differs from F-D-I neutral (both groups) and field dependent (experimental) (See Table 11).

The field dependent experimental group scores on the GEFT are significantly higher than those of the control group, suggesting that there was a training effect. A similar observation was made comparing experimental and control field dependents on the Scrambled Words Test. In the Paper Fold Test it is noted that the field dependent

and field independent scores are different in the control group, but do not significantly differ in the experimental group, again suggesting training effect. Another important observation is that, in the Scrambled Words Test, the field independents' scores are not different from the field dependent experimental group scores, suggesting that the treatment might have caused gain among the field dependents, while not affecting the field independents. Field independent scores show no difference between experimental and control group for any dependent variable, further supporting this observation.

Table 9

Q Statistic and Respective Critical Values(Qcv)
Newman-Keuls Method

Pair#

	1	4	2	5	3	6
Q=		**6.37	**8.07	**8.24	**13.52	**23.28
			1.70	1.86	**7.15	**7.34
				.16	**5.45	**5.64
					**5.28	*5.48
						.15
Qcv(.05) for df=109		2.80	3.36	3.68	3.92	4.10
			2.80	3.36	3.68	3.92
				2.80	3.36	3.68
					2.80	3.36
						2.80

*p<.05

**p<.01

Pair-Wise Comparisons of Means

- Pair #1 - Control Group x Field Dependence
- Pair #2 - Control Group x F-D-I Neutral
- Pair #3 - Control Group x Field Independence
- Pair #4 - Experimental Group x Field Dependence
- Pair #5 - Experimental Group x F-D-I Neutral
- Pair #6 - Experimental Group x Field Independence

Table 10

Q Statistic and Respective Critical Values(Qcv)
Newman-Keuls Method

Pair#	1	4	2	5	3	6
Q=		**5.86	**5.92 .06	**6.04 .18 .12	**6.45 .58 .52 .40	**7.56 1.70 1.64 1.52 1.12
Qcv (.05) for df=109		2.80	3.36 2.80	3.68 3.36 2.80	3.92 3.68 3.36 2.80	4.10 3.92 3.68 3.36 2.80

*p<.05
**p<.01

Pair-Wise Comparisons of Means

Pair #1 - Control Group x Field Dependence
 Pair #2 - Control Group x F-D-I Neutral
 Pair #3 - Control Group x Field Independence
 Pair #4 - Experimental Group x Field Dependence
 Pair #5 - Experimental Group x F-D-I Neutral
 Pair #6 - Experimental Group x Field Independence

Table 11

Q Statistic and Respective Critical Values (Qcv)Newman-Keuls Method

Pair#	1	4	2	5	6	3
Q=		2.54	3.14	**4.54	**5.93	**8.54
			.61	2.00	3.39	**6.00
				1.39	2.78	**5.39
					1.39	*4.00
						2.61
Qcv (.05) for df=109		2.80	3.36	3.68	3.92	4.10
			2.80	3.36	3.68	3.92
				2.80	3.36	3.68
					2.80	3.36
						2.80

*p<.05

**p<.01

Pair-Wise Comparisons of Means

- Pair #1 - Control Group x Field Dependence
- Pair #2 - Control Group x F-D-I Neutral
- Pair #3 - Control Group x Field Independence
- Pair #4 - Experimental Group x Field Dependence
- Pair #5 - Experimental Group x F-D-I Neutral
- Pair #6 - Experimental Group x Field Independence

Research Hypotheses and Findings

Chapter III presented three research hypotheses for investigation. Each hypothesis is reviewed here in regard to the relevant findings.

Hypothesis One:

Field independent subjects will perform significantly better than field dependents on complex restructuring tasks.

Field independent subjects significantly outscored field dependents on all three test tasks in the control group (See Table 2). The embeddedness task had very distinct levels of performance, and is the preeminent type of test used in identifying this construct. A major observation was the approximation of scores between the experimental group field dependents and control group field independents on the verbal disambiguating (Scrambled Word) task. Restated, experimental group field independents did not significantly outscore experimental field dependents, ($Q=1.39$, $Q_{cv}=2.80$), due to the effect of restructuring training (See Table 10). In the visual perspectivism task (Paper Fold Test) the F-D-I neutral was not significantly different from the field dependent group. Although the

extreme groups differed on the control condition, experimental group field dependents were more similar to experimental group field independents, presumably due to treatment effect (See Tables 2, 11).

Hypothesis Two:

Field dependent subjects receiving training and practice in restructuring strategies will score higher on subsequent restructuring tasks than subjects receiving no training or practice.

On the basis of the MANOVA, there is an overall training effect ($F [6,214] = 18.03, p < .01$). Training enhanced field dependents' performance on the embedded figures task and on the verbal disambiguating task, and to a lesser extent, on the visual perspectivism task, as measured by mean test scores. Field independent and F-D-I neutral groups were not responsive to the treatment, and had similar scores in control and treatment groups (See Table 2).

Hypothesis Three:

There will be interaction between Group (control and experiment) and F-D-I category (levels of field-dependence-independence).

There was interaction found for group (control/training) and F-D-I type on the dependent measures for embeddedness, verbal disambiguating, and perspectivism tasks. The source of the interaction was primarily between experimental and control group field dependents (See Figures 2, 3, and 4). Respective F-values and probabilities were, in order, $F(2,109) = 8.29, p < .01$; $F(2,109) = 10.00, p > .01$; $F(2,109) = 3.50, p < .05$.

Chapter V

SUMMARY AND DISCUSSION

Review of the Research Problem

The research was a straightforward design to determine if restructuring training could improve student performance on tasks known to require restructuring skills. Herman Witkin's research on the cognitive style field-dependence-independence characterized restructuring skills as a primary learning strategy brought to bear by field independent learners, but to a lesser extent by field dependent learners. Although first conceptualized as a fixed construct by Witkin, he later hypothesized that there probably exist greater degrees of malleability and mobility related to the field dependence dimension than originally thought. Individual differences among learners, a primary concern of instructional designers and teachers, might be minimized or accommodated if restructuring strategies become tools for the employ of all learners, field dependent as well as field independent.

The focus of this research was on three distinct tasks, each requiring the reorganization of an inherently organized field, or the organization of a disorganized

field, or both. The tasks were an embeddedness task, a task of visual perspectivism, and a task of verbal disambiguation. The treatment would be two lecture-type lessons with practice on incorporating restructuring strategies into the problem-solving approach of the learner.

Procedure

Learners were randomly assigned to the treatment or control group from class rosters, without the knowledge that they were to participate in the experiment. All students were tested for perceptual type using the Hidden Figures Test. One hundred fifteen participants completed the experiment. During the restructuring lessons, control group students were sent from the classroom to work on an unrelated independent study assignment in the library. It was the student expectation that each class member was completing a directed library assignment, one-half the class at a time. All participants were reassembled in the classroom for posttesting using the Group Embedded Figures Test, the Scrambled Word Test, and the Paper Fold Test.

Discussion and Conclusions

Field-dependence-independence differences have caused thousands of research projects to be undertaken, primarily because of the impact this construct has on learning. The propensity to express cognitive style in terms of one dimension or the other has caused instructional developers to attempt to minimize these differences by design of materials. This project attempted to show the possibility of compensating for these differences by affecting the learner rather than the learning materials. Reardon (1987) had indicated that an important research question for the future might be to "ask if it is necessary to manipulate the visual (materials) at all, or would some sort of training in strategy selection be more efficient?" (p.72)

In this study there was an observed significant difference in scores observed for treatment groups over control group field dependent subjects. This difference occurred on both the embeddedness task (GEFT, see Table 9) and the verbal disambiguating task (Scrambled Word Test, see Table 10). The mean scores between field dependent control and treatment groups for the Paper Fold Test (visual perspectivism) were different but not statistically significant. However, the similarity of field-dependent-independent scores among experimental participants on this

test task implies benefit from training in selection and use of restructuring strategies.

For field independent participants, it was concluded that there was no training effect for any of the posttest tasks. This is entirely consistent with the contention of other researchers, who generally hold that support strategies for field dependent learners have little effect on field independent learners (Britain, 1979; Grieve & Davis, 1971).

Field dependent performance in the experimental group approached the level of performance for field independents on the Scrambled Words Test and the Paper Fold Test (See Table 10, 11). For the means of these two groups, significant differential performance was not observed. An important finding, this can be explained in terms of gain on the part of field dependent participants due to training. It seems to indicate that, on the basis of restructuring training, these field dependent learners essentially made up for inherent differences between field dependents and field independents in performance on verbal disambiguating and visual perspectivism tasks, reenforcing the thesis that field dependent learners can experience mobility on field-dependence-independence measures.

Restructuring training can, therefore, differentially influence performance on certain tasks that require

solution strategies involving restructuring. Tasks requiring disembedding were those most enhanced by the treatment in this particular experiment. The explanation for the lesser success of the treatment for the other criterion tasks (Scrambled Words and Paper Fold) may be related to duration of the treatment. These tasks are much shorter than the disembedding tasks used. It is also possible that disembedding strategies are more quickly understood, tested, and incorporated than the verbal disambiguating or visual perspective strategies. Additionally, performance may be influenced by ability factors as well as by strategy selection. It is unknown which of the strategies of the restructuring lesson were most successfully retained and employed, and which were of little utility to field dependents.

On the basis of mean differences between control and experimental conditions, field dependent participants were the most likely to benefit from restructuring training. GEFT scores differed significantly from control to experimental (See Table 9), indicating training effect. Perhaps surprisingly, participants who were classified as relatively neutral on the field-dependence-independence continuum showed no treatment effect on any dependent task. It is not known whether these subjects perceived themselves

as having adequate strategies to deal with task solution, or whether they were able to more successfully emulate field independent behaviors. It would be consistent with current literature to relate the lack of effect to task difficulty (Dargel & Kirk, 1971) or information load (Bennick & Spoelstra, 1979), although the latter study dealt largely with memory tasks. For the restructuring tasks used in this experiment memory demands were minimized, since each task always had its question cue available to the participant. There may be, however, a memory component involved in retrieving or recalling restructuring strategies for use.

The tasks used for verbal disambiguating and for visual perspectivism are both well grounded in the literature (e.g., Carroll, 1974; Messick & French, 1975) as tasks requiring restructuring for solution, but may have been too short or too easy to constitute an adequate load demand. In other words, there may not have been sufficient difficulty or duration in these tasks for field dependents (and F-D-I neutral subjects) to develop and apply the strategies to which they were exposed.

The treatment showed significant effect compared to the control situation on the embeddedness test. The Scrambled Words Test and the Paper Fold Test showed difference in the experimental situation with F-D-I type, but not

across experimental and control groups. In practice, there may be different restructuring demands for the three restructuring tasks.

Recommendation and Implications for Further Study

Providing individual learners with restructuring strategies they can use in problem-solving is promising, but not thoroughly researched. The results of this study show directly the gains field dependent learners can make on restructuring tasks when provided training in selection and use of problem-solving strategies inherently used by field independents. When viewed by the instructional developer in conjunction with materials designed to address learner differences, the possibilities are potent.

Further research on field-dependence-independence and restructuring training is recommended with the following modifications to the present study proposed.

- A) Increase the training time to find an optimal level of training that produces effect.
- B) Increase the load (difficulty, duration, demand) on the restructuring tasks so the tasks have greater probability of finding significant effect.
- C) Address the adequacy of the lesson content, particularly in terms of specificity and directness toward the restructuring task.

For future research, emphasis should be placed on characterizing the field dependent who successfully adopts field independent-type restructuring strategies. Both a self-reported preference for learning strategies and a research-based comparison of successful strategies should be undertaken. Differentiation of field dependent individuals on the continuum for F-D-I with longevity and intensity of effect of restructuring training would provide much practical insight for dealing with basic learner differences. To follow up this particular study, research should be undertaken to compare results of designing instructional materials to assist field dependent restructuring with providing restructuring training for field dependents.

Research on cognitive restructuring ability should continue to be a priority among instructional developers. In the light of conflicting or inconclusive research, it is still not known whether field-dependence-independence is a spatial-visual dimension or a general cognitive dimension with a strong spatial-visual element (Linn & Kyllomen, 1981; Witkin & Goodenough, 1981). Restructuring is, however, known to be a functional element in predominance for field-dependence-independence, and a fundamental construct of differentiation theory.

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Appendix A

DEFINITION OF TERMS

Bipolar - indication of a construct characterized by a predisposition toward one end or the other of a continuum.

Cognitive Style - Individual differences among cognitive ego processes related to acquiring knowledge (Klein, 1958, cited in Kagan & Kogan, 1970); information processing habits representing certain typical modes of perceiving, thinking, remembering, and problem solving (Messick, 1970).

Differentiation - Sense of separate identity, or self- non-self segregation.

Disembedding Ability - The ability to find a given configuration within a distracting perceptual field (Ekstrom, French, & Harmon, 1976).

Field Dependence - Cognitive style of functioning identifying individuals whose perception relies on external referents. Characterized by need for structure and attendance to social cues and support. (Davis, 1973; Witkin, 1973).

Field Independence - Cognitive style of functioning at a higher level of autonomy, individuals who rely on internal referents when dealing with the perceptual field. Characterized by having the ability to restructure the perceptual field (Kelly, 1985).

Field dependent - (operational definition for this study)
An individual scoring relatively low (1-10) on the Hidden Figures Test (HFT).

Field Independent - (operational definition for this study)
An individual who scores relatively high (16 or above) on the Hidden Figures Test (HFT).

GEFT - Group Embedded Figures Test, adapted from the individually administered Embedded Figures Test (EFT) developed by Oltman, Raskin, and Witkin (1971). Used as a measure of perceptual disembedding ability.

HFT - Hidden Figures Test, adapted from the Gottschalt Figures type test for use as a measure of perceptual disembedding ability (Ekstrom et al., 1976).

Perception - The process of immediate experience in organisms; physical or mental stimulus interpreted in the light of experience.

Perceptual Style - Individual variation in modes of perceiving, rising from stylistic dimensions (Witkin, et al., 1971).

Perspectivism - The mental process of representing the spatial relation of objects with respect to position as they might appear to the eye.

Restructuring - The ability to impose structure on a field which has none, or to reorganize an ambiguous field. (Witkin, 1971)

Schema - A generic representation in memory of a concept, object, idea, or process containing a number of empty slots or place keepers. (Dansereau, 1982)

Verbal Disambiguation - The ability to restructure ambiguous verbal materials and stimuli. (Noble, 1984)

Appendix B

Listing of Strategies to Employ when Restructuring

Metacognitive plan for scanning, encoding, recall

Maintain a challenging pace

Attempt to organize the material your way

Break down a complex stimulus into elements

Provide a different structure than the inherent one

Gain information from both correct and incorrect

Utilize a schema like food/restaurant vs food/super
market

Try new or different approaches

Remember the spatial layout

Relate parts to whole

Completely survey the simple figure first; encode

Be active in search strategy

Longer, more random eye movements

Less blinking; avoid chaos or rigidity

Less erratic, more systematic scanning

Correspond eye tracings with hand tracings

Ignore irrelevant

Don't fix on the most obvious; resist misleading
stimuli

Avoid attending to one part of the field

Spend less time on specific parts

Appendix C

Lesson Outline for Restructuring Training Activity

I. Student handout--Listing of strategies to employ when restructuring

II. Lecture outline describing restructuring in field-dependence-independence and approaches used among successful restructuring problem-solvers

III. First session practice exercises and discussion; excerpts from:

Hidden Patterns Test (CF-1)

Incomplete Words (CV-3)

Identical Pictures Test (P-3)

Card Rotation Test (S-1)

Maze Tracing Speed Test (SS-1)

Surface Development Test (VZ-3)

IV. Second session practice exercises and discussion; excerpts from:

Copying Test (CF-3)

Hidden Words (CV-2)

Cube Comparisons Test (S-2)

Form Board Test (VZ-2)

V. Rationale for types of practice tasks

VI. List of all practice tests/posttests and sources

Appendix D

Restructuring Training Activity Lecture Outline

The restructuring training activity focuses on discussion and practice as outlined below. All student materials were projected by overhead transparency in addition to distribution to students.

1. Description of restructuring in presence of competing stimuli
 - a. Breakdown complex into elements
 - b. Provide structure for ambiguous stimuli
 - c. Provide a different structure than the most obvious or salient.
2. Eye movement strategies
3. Interrupt function
4. Student descriptions of strategies used
5. Practice in restructuring using Factor-Referenced Cognitive Tests from Educational Testing Service as practice tasks

Students who are being trained received a printed list of strategies, as well as practice handouts. These strategies as well as those suggested by students themselves, were demonstrated using restructuring

tasks. From the literature follows a compilation of strategies discussed or suggested for use in the restructuring lesson.

Instructor's Rationale for Practice Tasks

The series of tests related to flexibility of closure include the Hidden Patterns Test, the Copying Test, and the Hidden Figures Test. According to Educational Testing Service (ETS), this factor involves "the ability to hold a given visual precept or configuration in mind so as to disembed it from other perceptual material". This kind of test presents a problem whose solution requires the search of a distracting or ambiguous perceptual field. In addition to the tests named above, the Group Embedded Figures Test (Consulting Psychologists Press) is a well researched indicator of this ability. Research closely relates Witkin's field independence to Thurstone's flexibility of closure and Guilford's adaptive flexibility. Several researchers, including Wardell (1973) and Witkin (1962), suggest that figural adaptive flexibility, flexibility of closure, and field independence may be identical. Cattell (1971) calls this factor restructuring closure. The factor involves a short-term memory process to

image a figure in relation to its visual field.

Verbal closure requires restructuring of missing, scrambled, or embedded letters in visually-presented problems. Such tests include the Hidden Words Test, the Incomplete Words Test, and the Scrambled Words Test. Reorganization of the information must occur through typical restructuring techniques such as breaking complex into components, interrupting fixation on unsuccessful strategies, relating the parts to the whole, and others.

The Identical Pictures Test activates scanning strategies related to form discrimination. Carroll (1974) asserts that tasks of visual perceptual speed involve the temporal parameters of a visual search, while Kunnapas (1969) describes perceptual speed as immediate perceptual memory. Relationship of this factor to flexibility of closure and to restructuring are suggested by Ekstrom (1973) and Pawlik (1966).

The Card Rotation Test and the Cube Comparison Test require the ability to perceive spatial patterns or orientation of objects in space. It is thought that an object is first perceived as a whole then mentally restructured to its component parts for inclusion into short term visual memory for subsequent operations. There are an array of subfactors that further define

this factor, but it is generally accepted that spatial orientation has some relationship to visualization and to spatial egocentrism. The processes involved in mental rotation of shapes were described by Shepard (1971).

The Maze Tracing Speed Test requires the ability to quickly scan a field for a correct path, or spatial scanning. Spatial scanning is seen as speed in exploring visually a wide or complicated field, according to Carroll (1974). Successful subjects may employ a strategy involving simple willingness to test and reject incorrect trials visually, or to provide a different structure, such as tracing from the goal end rather than from the start.

Visualization is a factor usually described in connection with spatial orientation. Visualization is thought to be manipulative beyond simple figure rotation. Cattell (1971) relates this factor to flexibility of closure and figural adaptive flexibility, similar factors requiring analytic restructuring of the whole into components for tasks including the Form Board Test, Surface Development Test, and Paper Fold Test.

Appendix E

Listing of Practice Tasks and Posttests

TEST	SOURCE
Hidden Figures Test	Kit of Factor-Refer- enced Cognitive Tests (ETS)
Hidden Patterns Test	
Copying Test	
Scrambled Word Test	
Incomplete Word Test	
Hidden Words Test	
Identical Pictures Test	
Card Rotation Test	
Cube Comparison Test	
Maze Tracing Speed Test	
Form Board Test	
Paper Fold Test	
Surface Development Test	
Advanced Vocabulary Test II	
Group Embedded Figures Test	Consulting Psychol- ogists Press

VITA

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