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RELATIONSHIPS AMONG COGNITIVE STYLE FACTORS AND

PERCEPTUAL TYPES IN COLLEGE STUDENTS

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CHAPTER I

INTRODUCTION

Background of the Study

The past 30 years have seen the documentation in research literature of a groupof individual difference variables not discussed until the 1940's. At that time, psychological inquiry into differences in the cognitive process revealed the variables which have crystallized into the concept of cognitive style. This concept refers to psychological dimensions which represent consistencies in an individual's manner of acquiring and processing information.

Several primary dimensions or factors of cognitive style have been identified, and tests have been developed for their assessment. Three of the primary dimensions of cognitive style and associated testing instruments which have emerged have come from three principal research "camps." The leaders of these "camps" have been Herman Witkin, Jerome Kagan, and George Klein. Each group has identified and studied the dimension of cognitive style which it considers to be most important. There has been little effort, however, to examine these dimensions of cognitive style in terms of their relationships to each other or to determine if they are related to another perceptual variable: the perceptual typology developed by Viktor Lowenfeld. If cognitive style factors are interrelated, then a student's typical performance on one dimension of cognitive style may be related to his performance on other dimensions. This possibility has been almost completely ignored in available research literature. This study was designed to initiate examination of relationships among cognitive style factors by investigating the relationships among three major dimensions of cognitive style and Lowenfeld's structure of perceptual types.

In the research literature dealing with cognitive style, three dimensions which have emerged as being stable and the subjects of the most intensive investigation are:

1. field independence/field dependence
2. reflectivity/impulsivity
3. leveling/sharpening

Field independence/field dependence is concerned with the influence of the stimulus field on perception. Work in this area was begun by Gottschald and was continued by Witkin. Witkin and his associates conducted research which led to the conclusion that field factors influence some individuals far more than others (Witkin, 1950; Witkin et al., 1954; Witkin et al., 1962). Work with this perceptual variable led to the identification of two distinct styles of visual perception:

1. perception which is heavily influenced by field factors and the complexity of background, and

2. perception which is only slightly influenced by these factors.

These two styles of perception are referred to as field dependence and field independence, respectively. Field independence implies an analytical, as opposed to a global, way of perceiving stimuli which involves a tendency to perceive items as discrete from their background and demonstrates an ability to overcome an embedding context (Messick, 1966).

One type of task frequently used to determine the field independence/field dependence of an individual has been one which requires the subject to find a simple figure which is embedded within a more complex one. Examples are the Hidden Figures Test (French, Ekstrom, & Price, 1963) and Witkin's Embedded Figures Test. Those individuals who are able to perform such a task are identified as field independent; those who are not are identified as field dependent.

A second prominent dimension of cognitive style is the reflectivity/impulsivity dimension. This aspect of cognitive style is sometimes referred to as cognitive tempo. Cognitive tempo is basically concerned with the speed with which hypotheses are selected and information processed. The majority of the research on this cognitive dimension has been done by Kagan and his associates. Kagan (1966) states that in situations in which several response possibilities are available simultaneously, the impulsive subject reports the first hypothesis which occurs to him and is usually incorrect, while the reflective subject considers all possibilities before making a response and is usually correct.

The instrument most frequently used to assess cognitive tempo is Kagan's Matching Familiar Figures (Kagan, 1969). In this test, the subject is required to look at a criterion drawing and then pick out an exact duplicate of it from among numerous variant alternatives.

A third dimension which has emerged from the research on cognitive style is the leveling/sharpening dimension. This dimension originated in the research of Klein (1951, 1958), and has been studied extensively by Santostefano. The leveling/sharpening dimension deals with the manner in which an individual perceives and stores gradual changes in sequentially experienced stimuli. Levelers tend to merge new experiences with memories of earlier experiences. They therefore construct relatively undifferentiated memories and impressions of ongoing experiences. Sharpeners tend to maintain discrete impressions and memories of sequentially presented stimuli so that elements do not lose their individuality (Santostefano, 1971). The Leveling-Sharpening House Test (Santostefano, 1971) is frequently used to assess this dimension of cognitive style. It measures the accuracy and speed with which a subject detects changes in pictorial stimulus material.

Another individual difference variable which may have important relationships to cognitive styles which have not been thoroughly investigated is perceptual type. In his research in art education, Lowenfeld (1939, 1945, 1957) identified individuals of two distinct perceptual types. These two types, which he called visual and haptic, he believed to have two unlike manners of perceiving and reacting to the world of experience. He developed a battery of tests (Lowenfeld, 1945) through which the perceptual type of an individual may be identified.

An individual of the visual perceptual type tends to use the eyes as the main intermediaries for sensory impressions. The visual type is perceptually an observer, usually approaching things from their appearance and feeling as a spectator. The tendency is to transform kinesthetic and tactile experiences into visual ones (Lowenfeld, 1945).

A haptic individual is a normally-sighted person who uses the eyes as the primary sensory intermediaries only when compelled to do so, preferring to rely on touch and kinesthesis. The main intermediary for the haptic type is the "body-self" - muscular sensations, kinesthetic experiences, touch impressions, and other physical sensations. The haptic is subjective and does not transform kinesthetic and tactile experiences into visual ones (Lowenfeld, 1945).

Lowenfeld's extensive studies (1945) revealed that the distribution of visual and haptic perceptual types is stable across populations. Lowenfeld found that while most people fall between the extremes of the two types, few individuals have equal tendencies toward visual and haptic perception. He found consistently in all the subpopulations he tested that about 75% of the subjects showed appreciable tendency toward one type or the other. Not quite 50% showed visual tendency and not quite 25% showed haptic tendency. He thus established the following approximate theoretical distribution of perceptual types for any given population: visual, 50%; indefinite, 25%; and haptic, 25%. This distribution coincides very closely with that found by Walter (1963) with the use of an electroencephalograph for what he called "visualizers," "non-visualizers," and "mixed types."

A motion picture testing instrument developed for the Army Air Corps, Successive Perception Test I, is an instrument which has been frequently used to assess perceptual type. The test is based on one of the principal differences between visuals and haptics in perceptual functioning. It requires the mental integration of a visual image revealed a small piece at a time. Visuals typically can perform this function, while haptics typically cannot.

Lowenfeld postulated several important distinctions between the perceptual functioning of visual and haptic individuals. These distinctions include the following:

1. While the visual has the ability to see a whole, break it up and see its component details, and then resynthesize the details back into a whole, the haptic is unable to do this.

2. While the visual tends to react to stimuli as a spectator and to "see" experiences, the haptic tends to react emotionally, to "feel" stimuli, and to put himself into the situations which are experienced.

3. While the visual has the tendency and ability to visualize tactile experiences and to visually complete partial experiences, the haptic has neither this tendency nor ability.

4. While the visual has the ability to mentally retain visual images, the haptic is unable to do this.

These distinctions form an important component of the theoretical rationale for the present study. A second important theoretical component is the theoretical model of cognitive processes proposed by Fletcher (1969). According to this model, cognition consists of the following steps or groups of processes:

1. attentional processes: processes which serve to detect the cues relevant to the particular problem at hand

2. transformation processes: processes which serve to encode appropriate information

3. generation processes: processes which serve to generate solutions to the problem

4. evaluation processes: processes which serve to determine if solution has been achieved

All four of these groups of processes are linked to the memory and interact with it. Figure 1 shows Fletcher's model of cognitive processes.

Since an individual "responds only to encoded information, never to actual stimuli" (Fletcher, 1969, p. 8), the transformation step in the cognitive process is fundamental and vital. The generation of solutions is, according to Fletcher's model, based upon how input stimuli are transformed by the learner. Fletcher (1969) hypothesized two principal types or styles of

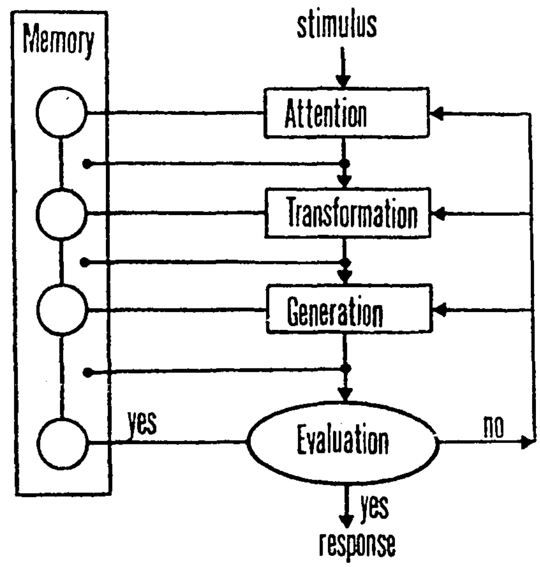

Figure 1. Fletcher's operational model of cognitive processes. (Fletcher, 1969, p. 8)

transformation: the analytic style, in which stimuli are broken doen into individually meaningful elements; and the synthetic style, in which stimuli are grouped globally into whole. To Fletcher, the manner in which solutions to problems are generated is necessarily dependent upon which type of transformation is used by an individual. It therefore follows that a task which requires a specific type of transformation for its solution cannot be satisfactorily performed by a learner who is incapable of the necessary type of transformation.

It should be recalled that the nature of the tasks used to assess the principal dimensions of cognitive style require the discrimination and separation of visual stimuli. This means that, in Fletcher's terminology, analytic transformation and memory storage of visual stimuli are required for the correct generation of the solution to these tasks. It is apparent from

Lowenfeld's distinctions between visuals and haptics that this manner of handling visual stimuli is theoretically readily available to persons of the visual perceptual type, but is not readily available to persons of the haptic type. This implies that performance on these cognitive style assessment tasks could be expected to be influenced by an individual's perceptual type. The present study was designed to test the validity of this implication.

Statement of the Problem

The problem for this study was as follows: Are the cognitive style factors of field independence/field dependence, reflectivity/impulsivity, and leveling/sharpening related to each other and to Lowenfeld's concept of visual and haptic perceptual types?

Purpose of the Study

It was the purpose of this study to determine in what ways three principal dimensions of cognitive style are related to each other and to the concept of perceptual types as defined by Lowenfeld. Three general questions were investigated:

1. Are visual and haptic perceptual types distributed in various cognitive style sub-populations as predicted from Lowenfeld's theoretical distribution of perceptual types?

2. Can performance on measures of cognitive style discriminate categories of perceptual type?

3. What kind of factor structure do measures of cognitive style and perceptual type produce in a factor analysis?

Statement of Hypotheses

Rationale for hypotheses. Application of the theoretical base provided by Lowenfeld and Fletcher lead to the conclusion that performance on visual tests of cognitive style is influenced by perceptual type. The haptic type could be expected to transform and store visual stimuli synthetically and to react emotionally, thus testing out as field dependent, impulsive, and leveling. The distribution of visuals and haptics in field dependent, impulsive, and leveling populations would therefore be the reverse of Lowenfeld's theoretical distribution. This reversal should result in a statistically significant difference between expected (theoretical) and observed frequencies of visual and haptic types in these populations.

The visual type, on the other hand, could be expected to transform and store visual stimuli analytically and to react impersonally, thus testing out as field independent, reflective, and sharpening. Lowenfeld's theoretical distribution would place visuals and haptics in these populations in a ratio of two to one, thus making them predominantly visual. It was expected that the actual observed frequencies of perceptual types in these populations would increase this ratio of visuals to haptics. Whether the difference in expected and observed frequencies would be statistically significant was expected to be largely a matter of statistical power and instrument sensitivity.

Finally, if visual and haptic performances on visual tests of cognitive style are typically different, performance on these tests was expected to discriminate between the two perceptual types.

Specific hypotheses. The following were the hypotheses tested in the study:

H_{01}: There is no difference between the obtained and expected frequencies of visual and haptic types among field dependent subjects.

H_1: The obtained frequency of visual types among field dependent subjects is smaller than the expected frequency.

H_{02}: There is no difference between the obtained and expected frequencies of visual and haptic types among field independent subjects.

H_2: The obtained frequency of haptic types among field independent subjects is smaller than the expected frequency.

H_{03}: There is no difference between the obtained and expected frequencies of visual and haptic types among reflective subjects.

H_3: The obtained frequency of haptic types among reflective subjects is smaller than the expected frequency.

H_{04}: There is no difference between the obtained and expected frequencies of visual and haptic types among impulsive subjects.

H_4: The obtained frequency of visual types among impulsive subjects is smaller than the expected frequency.

H_{05}: There is no difference between the obtained and expected frequencies of visual and haptic types among sharpening subjects.

H_5: The obtained frequency of haptic types among sharpening subjects is smaller than the expected frequency.

H_{06}: There is no difference between the obtained and expected frequencies of visual and haptic types among leveling subjects.

H_6: The obtained frequency of visual types among leveling subjects is smaller than the expected frequency.

H_{07}: The cognitive style predictor variables do not discriminate between the criterion categories of perceptual type.

H_7: The cognitive style predictor variables discriminate between the criterion categories of perceptual type.

Limitations of the Study

One limitation of this study lies in the fact that all subjects were drawn from undergraduates enrolled in Education 4160, Media and Technology in Teaching, at the University of Oklahoma. Generalization of the results of the study beyond this population is therefore valid only to the extent that the population sampled is representative of other populations.

A second limitation of the study is that no test was given to determine if any of the subjects had visual handicaps.

All subjects were questioned concerning visual handicaps, and all reported that they had no such handicaps except those ameliorated by corrective optics. It was assumed, on this basis, that all subjects were normally sighted or wore optics which gave them normal visual acuity. All subjects who reported that they wore corrective optics were required to wear them during all testing for this study.

A final limitation of the study is that no attempt was made to examine or control for differences in perceptual functioning and patterns between male and female subjects or between the Caucasian racial majority and ethnic minorities. Since some differences in perceptual performance have been observed between these groups and since the sample used was not drawn at random, this may have had some bearing on the results of the study which was not accounted for in the data analysis. The sample for this study consisted of 206 undergraduates, with a ratio of female to male of approximately 2.3 to one and a total of 12 individuals of racial minorities.

Operational Definition of Terms

The following definitions were applied in this research:

Visual perceptual type (Visual): Subjects who scored 60% or more correct on Successive Perception Test I were classified as visual.

Haptic perceptual type (Haptic): Subjects who scored 60% or more incorrect on Successive Perception Test I were classified as haptic.

Field independent: Subjects who scored in the upper one-third of the sample on the Hidden Figures Test were classified as field independent.

Field dependent: Subjects who scored in the lower one-third of the sample on the Hidden Figures Test were classified as field dependent.

Reflective: Subjects who scored below median errors and above median mean latency on Matching Familiar Figures were classified as reflective.

Impulsive: Subjects who scored above median errors and below median mean latency on Matching Familiar Figures were classified as impulsive.

Leveler: Subjects whose leveling-sharpening ratio on the Leveling-Sharpening House Test was in the upper one-third of the sample were classified as levelers.

Sharpener: Subjects whose leveling-sharpening ratio on the Leveling-Sharpening House Test was in the lower one-third of the sample were classified as sharpeners.

Significance of the Study

This study was designed to see if relationships exist between perceptual types and performance on various types of visual cognitive style tests. Attempts have not been previously made to examine cognitive style variables solely as aspects of visual functioning. If relationships among these variables can be demonstrated, several implications can be drawn. First, the variables identified by Lowenfeld, Witkin, Kagan, and Klein can be tied together in a new way: as aspects of visual functioning and style. Second, more will be known about specific manifestations of visual and haptic perceptual functioning. Third, foundations can be laid for the development of theoretical models of visual and haptic perceptual functioning. Fourth, utilization principles for visual media can be developed from the knowledge that a whole cluster of perceptual traits tend to be found together. This knowledge would clearly indicate the necessity for the use of classroom learning tasks and presentation modes to match perceptual style preferences or to supplant perceptual weaknesses, perhaps through the use of specially designed media presentations of stimuli. As many as one-fourth of students may be unable to perform certain types of tasks presented via certain types of visual stimuli.

CHAPTER II

REVIEW OF SELECTED LITERATURE

The review of literature presented here represents major research concerning the dimensions of cognitive style which are major variables in the present study.

The Concept of Cognitive Styles

The term cognitive style refers, in general, to differential psychological dimensions which represent consistencies in an individual's manner of acquiring and processing information.

Kogan states that cognition "refers to the process by which knowledge is acquired: perception, memory, thinking, and imagery" (Kogan, 1971, p. 243). It is only recently that individual differences in this process have begun to be systematically studied. Kogan states that:

> Unlike ability, personality, and value constructs, all of which have been intimately involved in educational practice for several decades, the concepts of cognitive styles have penetrated the educational scene to only a minor extent (Kogan, 1971, p. 243).

Investigators have explored the area of individual differences in cognitive functioning from diverse theoretical viewpoints and with a variety of techniques. A diversity of labels has been introduced to describe the basic area of individual differences in cognition. These differences are variously referred to as cognitive styles, cognitive controls, cognitive strategies, and modes or habits of information processing. These verbal distinctions, however, are "more a matter of differences in the theoretical orientation of the investigator than of differences in the phenomena" (Kogan, 1971, p. 245). Because it appears to be the most frequently used label, the term cognitive styles is the one which will be applied by this author to the phenomenon of consistent individual differences in cognitive functioning.

Several researchers have defined the concept of cognitive styles. Nelson defines cognitive styles simply as psychological "dimensions which represent consistencies in an individual's manner or form of cognition" (Nelson, 1973, p. 15). Messick states that cognitive styles "represent a person's typical modes of perceiving, remembering, thinking, and problem solving (Messick, 1966, p. 9). Kogan offers the following definition of cognitive styles which distinguishes them clearly from abilities:

> Cognitive styles can be most directly defined as individual variation in _modes_ of perceiving, remembering, and thinking, or as distinctive ways of apprehending, storing, transforming, and utilizing information. It may be noted that _abilities_ also involve the foregoing properties, but a difference in emphasis should be noted: Abilities concern level of skill - the more and less of performance - whereas cognitive styles give greater weight to the _manner_ and _form_ of cognition (Kogan, 1971, p. 244).

Messick (1966) listed and described the following nine separate cognitive style dimensions which have been the objects of systematic theoretical and empirical examination:

1. <u>Field independence vs. field dependence:</u> an analytical, in contrast to a global, manner of perceiving stimuli which entails a tendency to experience items as discrete from their backgrounds and reflects ability to overcome the influence of an embedding context.

2. <u>Scanning:</u> a dimension of individual differences in the extensiveness and intensity of attention deployment, leading to individual variations in the vividness of experiences and the span of awareness.

3. <u>Breadth of categorizing:</u> consistent preferences for broad inclusiveness, as opposed to narrow exclusiveness, in establishing the acceptable range for specified categories.

4. <u>Conceptualizing styles:</u> individual differences in the tendency to categorize perceived similarities and differences among stimuli in terms of many differentiated concepts, which is a dimension called conceptual differentiation, as well as consistencies in the utilization of particular conceptualizing approaches as bases for forming concepts (such as the routine use in concept formation of thematic or functional relations among stimuli as opposed to the analysis of descriptive attributes or the inference of class membership).

5. <u>Cognitive complexity vs. simplicity:</u> individual differences in the tendency to construe the world, and particularly the world of social behavior, in a multidimensional and discriminating way.

6. Reflectiveness vs. impulsivity: individual consistencies in the speed with which hypotheses are selected and information processed, with impulsive subjects tending to offer the first answer that occurs to them, even though it is frequently incorrect, and reflective subjects tending to ponder various possibilities before deciding on a response.

7. Leveling vs. sharpening: reliable individual variations in assimilation in memory. Subjects at the leveling extreme tend to blur similar memories and to merge perceived objects or events with similar but not identical events recalled from previous experience. Sharpeners, at the other extreme, are less prone to confuse similar objects and, by contrast, may even judge the present to be less similar to the past than is actually the case.

8. Constricted vs. flexible control: individual differences in susceptibility to distraction and cognitive interference.

9. Tolerance for incongruous or unrealistic experiences: a dimension of differential willingness to accept perceptions at variance with conventional experience.

To Messick's list, Kogan adds one more cognitive style dimension: risk-taking versus cautiousness. He says that this dimension refers to "individual differences in choice of 'high payoff - low probability' options relative to 'low payoff - high probability' options" (Kogan, 1971, p. 245).

Because they have emerged in research literature as dominant, because they appear to be most closely related to visual perception, and because they are of intuitive and theoretical interest to the author, three of these dimensions of cognitive style were selected as variables for the present study. Each of these dimensions will be discussed in its section of the review of literature which follows.

The Reflectivity/Impulsivity Dimension of Cognitive Style

A definition of the dimension. The reflectivity-impulsivity dimension of cognitive style is concerned in general with the speed with which hypotheses are selected and information is processed. This dimension is frequently referred to as cognitive, perceptual, or conceptual tempo. Kagan, who has been the leading investigator of cognitive tempo, defines the dimension as follows:

> The reflection-impulsivity dimension describes the degree to which a child reflects upon the differential validity of alternative solution hypotheses in situations where many response possibilities are available simultaneously. In these problem situations the children with fast tempos impulsively report the first hypothesis that occurs to them, and this response is typically incorrect. The reflective child, on the other hand, delays a long time before reporting a solution hypothesis and is usually correct (Kagan, 1066a, p. 119).

Of the testing instruments which have been used to assess reflectivity-impulsivity (see Nelson, 1973, pp. 23-24) Matching Familiar Figures (Kagan, 1969) has become the "basic index" (Kogan, 1971). This instrument requires the subject to look at a picture and then select an exact duplicate of it from among numerous similar variants. The dependent variables, which consistently show a negative correlation, are response time and errors.

Stability of cognitive tempo over time. Cross-sectional studies indicate that absolute degree of reflectivity tends to increase with age. Kagan reports a "linear increase in response time and decrease in errors" with age (Kagan, 1966a, p. 121). Research has shown that over an age range of five to eleven years there is a progressive increase in response time and a corresponding decrease in errors, with a negative correlation between the two variables at all ages (Kogan, 1971). Such increases and decreases are easily observed by comparing group mean error and response scores at various age levels. However, since an individual's cognitive tempo is assessed at any given age level not by an absolute standard, but by comparing his errors and latency performance to median performances for a group of his own age, it is also possible to determine whether his tempo remains stable in comparison to his peers. This type of analysis has shown that, despite a general age-group shift toward reflectivity, an individual's reflectivity or impulsivity relative to his age group is quite stable over time.

Kagan states that existing evidence suggests that impulsivity begins its growth during preschool years and may be a deeply entrenched habit in some individuals (Kagan, Rosman, Day, Albert, & Phillips, 1964). Studies by Kagan (1965a) and his associates (Kagan et al., 1964) demonstrate stability of cognitive tempo in yound children over time periods of various lengths. Yando (1968) conducted a study with second-grade children over a ten-week period which yielded a mean correlation for response times of .70. Messer (1968, 1970) reports stability coefficients ranging from the low .60's to the low .30's for time intervals between one year and two-and-one-half years.

Stability of cognitive tempo over tasks. Generality of cognitive tempo appears to be considerable over diverse tasks as well as stable over time. The tendency to respond reflectively or impulsively is reported by Kagan to be manifested across "virtually all" tasks which have the property of response uncertainty (Kagan et al., 1964). It is also reported to be characteristic of tasks in which a child must generate his own alternative hypotheses (Kagan, 1965b). In a summary of research of cognitive tempo, Kogan (1971) reports that in studies examining reflectivity-impulsivity on various tasks involving response uncertainty, intertask correlations have ranged from the .40's upward.

Implications and correlates of cognitive tempo. Kogan states that of the nine dimensions of cognitive style listed by Messick (see pp. 18-19), "the reflection-impulsivity dimension has the most direct implications for the educational process" (Kogan, 1971, p. 266). He states in his discussion of cognitive tempo that "correlations between reflection-impulsivity and ability measures tend to be positive for response time and negative for number of errors ...." (Kogan, 1971, p. 267). Kagan and his associates have examined correlates of reflectivity-impulsivity in the domains of inductive reasoning and educational achievement. In one such study (Kagan, Pearson, & Welch, 1966a), the relationship between cognitive tempo and indictive reasoning was investigated. Three inductive reasoning tasks were administered to a sample of first-grade children. Impulsive children were found to respond more quickly and to make more errors on the inductive reasoning tasks. These relationships remained statistically significant when verbal ability, as measured by the WISC, was controlled.

Kogan points out that the relationship between impulsivity and poor performance on inductive reasoning tasks and other tasks involving response uncertainty may extend to performance on tests of general intelligence:

> Since intelligence tests for children often include subtests of inductive inference as well as other subtests containing response uncertainty, one might well expect the impulsive child's performance on such subtests to be substantially hindered. Of necessity, overall IQ scores would also be diminished as a direct consequence. (Kogan, 1971, p. 267).

The debilitating effects of impulsivity on inductive reasoning and tasks involving response uncertainty may be analogous to those of field dependence on the analytical cluster of WISC subtests (see pp. 40-41). Although this possibility has not been investigated empirically, it appears to the author to merit such investigation.

One correlate of cognitive tempo which is directly related to school success and failure is reading ability. In a study by Kagan (1965a), errors in reading prose were found to be related to an impulsive tempo. Kagan hypothesized that reflective children would committ fewer word recognition errors than impulsive children because they were more apt to evaluate the validity of several possible responses before responding. He assessed the reading ability of reflective and impulsive first-graders with letter and word recognition tests. As hypothesized, Kagan found high error scores on tests of cognitive tempo to be good predictors of high error scores on the recognition tests. Although high verbal ability, as measured by WISC, was associated with fewer recognition errors, impulsiveness remained significantly related to such errors when verbal ability was statistically controlled. When the sample was divided into children of high and low verbal ability and separate correlations computed between errors on cognitve tempo tests and on letter/word recognition tests, Kagan's major finding was largely confined to the children of high ability. He presumed the low-ability children to be affected more by conceptual deficits and the high-ability children to be more affected by manner of dealing with response uncertainty. Thus, delay in response for low-ability children was interpreted as a reflection of incompetence rather than of careful consideration of the available alternatives. Kagan retested the same group of children after a one-year interval and found that while there was no relationship between cognitive tempo and improvement in reading over that time period, the impulsive children still made more reading errors. There errors were primarily involved with substitutions of graphemically similar words for the actual word, such as reading truck for trunk.

In a more recent study Ausburn, Back, and Hoover (1976) found that high school students between the ages of 15 and 17 diagnosed as below grade level in silent reading ability as measured by the Reading for Understanding Placement Test (Thurstone, 1963) were more impulsive than students classified as at or above grade level. The remedial reading group had significantly higher error scores and lower response times than the non-remedial group.

Memory is another area in which a relationship between cognitive tempo and performance has been demonstrated which has specific bearing on scholastic success. In a study by Kagan (1966b), third-grade impulsive children were shown to make more errors of commission than their reflective peers on a task involving serial recall of 12 familiar words. When anxiety was aroused with threats of failure in an experimental group but not in a control group, it was observed that the anxious children made more errors of commission than control children. However, differences between impulsives and reflectives were still observed. Impulsive children showed relatively little increase in errors over their baseline levels. Reflective children, on the other hand, showed a large increase in errors when anxiety was heightened. Kagan concluded that reflective children perform better than impulsive ones in serial recall tasks, and that it is possible to disrupt the more accurate performance of reflective children, who are normally anxious about making errors, by increasing this anxiety with threats of failure.

Kagan and his associates have concluded that impulsivity can have a generally detrimental effect on scholastic success, at least in part because it makes teachers view a child unfavorably:

> Impulsive children do not seem to care about making making mistakes for they offer answers quickly and without sufficient consideration of the probable accuracy of their solution. This disposition is often a handicap in the typical school situation, for most teachers do not have a high tolerance for incorrect replies .... (Kagan, Pearson, & Welch, 1966b, p. 359).

A study by Messer (1970) sought to determine if a relationship exists between reflectivity-impulsivity and general school failure. Messer discovered that first-grade boys who were held back a year were significantly more impulsive than a similar group who advanced normally. Significant differences in response time and errors on Matching Familiar Figures were observed between the two groups during the initial testing during the first grade and 2.5 years later. Since verbal intelligence was controlled for the two groups, this was eliminated as a cause for the difference in school promotion. Whether the observed relationship of impulsivity to school failure was due to the poor opinion which Kagan suggests teachers tend to form of impulsive children, to the relationship of impulsivity to poor performance on specific learning tasks demonstrated in previously-cited research, or to some factor as yet undiscovered, is not concluded by Messer. But for whatever reason, it appears that impulsive children are more likely than reflective ones to experience school failure.

Modifiability of cognitive tempo. The question of the degree to which cognitive tempo is modifiable has been the subject of a small number of empirical studies. In one of the earliest attempts to investigate this question (Kagan, Pearson, & Welch, 1966b), impulsive first-grade children (measured with Matching Familiar Figures) were divided into two training groups and one control group. The training consisted of a required 15-second inhibition of the giving of a response. Some children were trained by a trainer with whom they were made to feel similar; others were trained by trainers with whom no similarity was encouraged. The presence or absence of similarity between child and trainer made no significant difference in modifying impulsive tempo. However, apparently as a result of several 30-minute training sessions, the trained children, in subsequent testing with a strange examiner, did manifest longer response latencies even though no time constraints were imposed. No effect on error scores, however, was observed in the groups receiving training; nor did the effects of training generalize significantly to the Picture Completion Reasoning Test, a measure of inductive reasoning involving response uncertainty.

In a more recent study (Debus, 1970), modeling procedures were used in a effort to modify response times. Third-grade children were exposed to sixth-graders of the same sex who had been trained to respond either impulsively or reflectively. Cognitive tempo was assessed both immediately after exposure to the model and 2.5 weeks later. In general, the children exposed to a reflective model became slower, while those exposed to an impulsive model became faster. As was observed in the Kagan study (Kagan, Pearson, & Welch, 1966b), however, no effects on error scores were observed. It therefore appears that training focusing on response time may have the effect of reducing the sizeable negative correlations normally obtained between response time and errors on measures of cognitive tempo.

An attempt was made by Yando and Kagan (1968) to modify tempo in the naturalistic setting of the classroom. First-grade teachers were classified as reflective or impulsive with Matching Familiar Figures (adult form). A random sample of children selected from each classroom was tested for cognitive tempo with Matching Familiar Figures (children's form) in the fall and again in the spring. The results indicated a shift in the children's tempo in the direction of the tempo of the teachers to whom they had been exposed. These shifts were of substantial magnitude, however, only the case of impulsive children exposed to experienced reflective teachers. Consistent with research previously cited, only the children's response time was influenced by teacher tempo; error rates were not significantly affected.

The studies cited here suggest that the tendency to respond quickly or slowly is more amenable to training than are the skills underlying accurate perceptual discrimination. The author agrees with Kogan that "the reduction of error rates evidently requires specific training in scanning visual arrays" (Kogan, 1971, p. 269).

Teacher-pupil matching on cognitive tempo. In view of the findings which indicate that at least some effects are observable when children with reflective or impulsive tempos are exposed to teachers with opposite tempos, consideration should be made of potential educational advantages of pairing students with impulsivity or reflectivity sufficiently extreme to be debilitating with teachers of opposite tempos. Children whose extreme impulsivity is resulting in reading or memory difficulties may be benefitted by exposure to a highly reflective teacher. On the other hand, exposure to impulsive teachers may be beneficial to extremely reflective, overcautious children. These suggestions are admittedly speculative. At this time, there is very little empirical data to support them. It should also be noted that such teacher-pupil pairings of opposites are likely to be beneficial only in cases where a child's impulsivity or reflectivity reaches detrimental extremes; that is, where impulsivity contributes to damagingly high error rates or where reflectivity leads to high levels of indecisiveness. Kogan urges the following caution concerning teacher-pupil pairing in cognitive tempo:

> Where ... impulsiveness and reflectiveness are associated with superior cognitive performance ..., teacher-pupil similarity may be more appropriate than teacher-pupil differences from the point of view of facilitating cognitive development. Consider, for example, the difference between impulsive children of high and low ability. An impulsive teacher is likely to associate quickness with intelligence, and will tend to reward bright, impulsive children who rapidly respond to questions with correct answers. The less-able impulsive child may well be handicapped in such a classroom setting, however, since speed of response will be associated with inaccurate answers in his case. Such a child is being taught to value quickness, but this can only have the effect of enhancing the likelihood of failure. (Kogan, 1971, p. 270).

In view of the issues as yet unresolved by research, it appears that teacher-pupil matching on the reflectivity-impulsivity dimension is not yet practical in school settings.

Factors underlying cognitive tempo. Several motivations underlying the disposition toward reflectivity or impulsivity have been proposed by Kagan and Kogan (1970):

> One possible dynamic that might distinguish reflectives and impulsives concerns possible differences in the source of anxiety in intellective problem-solving situations. For the reflective child, anxiety derives from the expectation that making mistakes is associated with incompetence. Hence, the reflective child pursues a strategy that will minimize the likelihood of error. Anxiety in the case of the impulsive child, on the other hand, derives from the expectation that incompetence is linked to slowness. Accordingly, the impulsive child follows a strategy of responding quickly, hence risking a higher rate of error. This alternative presumes that anxiety, although having different sources, is present in both reflectives and impulsives. Minimal anxiety would then be associated with a strategy that is neither extremely reflective nor extremely impulsive.
>
> An alternative dynamic ... assumes a direct relationship between anxiety over error and reflectiveness. Viewed in this manner, impulsive performance implies minimal anxiety about potentially inaccurate responses, and extremely reflective performance is suggestive of a wish to avoid error at all costs (Kogan, 1971, pp 270-271).

The latter interpretation is supported by eye-movement data (Drake, 1970) indicating that impulsive subjects do not scan all of the alternatives in the Matching Familiar Figures test before making a response. Reflective subjects, on the other hand, make a careful visual search of the standard and all of the variants before making a response. The present study attempts to determine if visual perceptual style and capabilities are also related to the tendency toward reflectivity or impulsivity. If this relationship is demonstrated, it can be proposed that lack of ability to deal with visual stimuli in an analytical and reflective manner is another underlying factor of reflective and impulsive cognitive tempos.

The Field Independence/Field Dependence Dimension of Cognitive Style

A definition of the dimension. Field independence/field dependence is a part of a highly complex dimension of cognitive style called psychological differentiation or analytic versus global field approach (Witkin, Dyk, Faterson, Doogenough, & Karp, 1962). In a ten-year period of research, Witkin and his associates identified a dimension of perception and personality roughly corresponding to activity/impassivity in dealing with the environment and an ability to overcome an embedding context in a stimulus field.

Work in the influence of stimulus field on perception was begun by Gottschaldt, who hypothesized that contextual factors influence perception. The results of his work led to the conclusion that contextual factors alone could not fully explain his findings. He later hypothesized that there existed stable and consistent individual differences in perceptual performance and that these were an important factor in understanding the perceptual process (Witkin, 1950).

Gottschaldt's work was continued by Witkin and his associates, whose research led to the conclusion that field factors influence some individuals far more than others. Work with this variable led to the identification of two distinct types of perception: perception which is heavily influenced by field factors, and perception which is only slightly influenced by these factors.

The early studies by Witkin (1949) in field influence on perception were concerned with individual differences in the ability to establish the upright in an embedding field. He was interested in determining if there were differences in the use of visual or kinesthetic cues in the orientation of self to the vertical in space. He hypothesized that some individuals utilize the cues provided by the visual field, while others utilize the cues provided by the pull of gravity on the body. He believed that the use of subtle kinesthetic cues represented a more analytical perceptual style than the conformity to cues provided by the visual field. Witkin used three tests which required subjects to orient themselves to a tilted visual field and establish true vertical. He called field dependent those who were tied to the framework established by the tilted visual field and were unable to overcome its embedding context by establishing true vertical. Those who were able to overcome context and use the analytic cues provided by physical sensations to establish the upright he called field independent. The results of Witkin's studies revealed a tendency toward field independence with increasing age, but at no uniform rate. The only tendency he observed toward increasing reliance on the visual field was in females between the age of thirteen and adulthood. Witkin also observed sex differences in perceptual functioning. He observed boys to be markedly more field independent than girls at eight years of age. This difference gradually diminished between the ages of eight and thirteen, but reappeared at the adult level.

Somewhat later, Witkin and his associates established personality correlates to field independence and dependence:

> Field-dependent persons tend to be characterized by passivity in dealing with the environment; by unfamiliarity with and fear of their own impulses together with poor control over them; by lack of self-esteem; and by the possession of a relatively primitive, undifferentiated body image. Independent or analytical perceptual performars, in contrast, tend to be characterized by activity and independence in relation to the environment; by closer communication with, and better control of, their own impulses; and by relatively high self-esteem and a more differentiated, mature body image (Witkin, Lewis, Hertzman, Machover, Meissner, & Wapner, 1954).

This statement suggests a relationship between the Witkin field independence/dependence dimension of cognitive style and Kagan's reflectivity/impulsivity dimension. Although no such relationship has been investigated previously, the present study does make such an investigation.

Witkin postulated a general field dependence, or differentiation, hypothesis based on the relationships he found between field dependence/independence and personality factors. Young (1959) tested this hypothesis and, while his results were not as striking as Witkin's, they did lend considerable support to the notion of different personalities which tend to accompany field independent and field dependent perception.

Witkin began to stress the element of embeddedness in differentiation and to refer to the analytical and global nature of field independence and dependence, respectively. By 1962, he defined the opposite perceptual styles as follows:

> The person with a more field-independent way of perceiving tends to experience his surroundings analytically, with objects experienced as discrete from their backgrounds. The person with a more field-dependent way of perceiving tends to experience his surroundings in a relatively global fashion, passively conforming to the influence of the prevailing field of context (Witkin *et al*., 1962).

This definition stresses the ability to overcome the embedding context of a background field. However, it no longer stresses the concepts of reliance on global *visual* field as opposed to ability to use analytical *kinesthetic* cues.

Karp (1963) hypothesized that field dependence involves ability to resist distraction rather than ability to overcome the effects of embedding context. He performed a factor-analytic study in which 150 male college students were given a battery of 18 tests, including tests of field independence, WAIS subtests, adaptive flexibility measures, and measures of abilit to resist distraction. A factor analysis supported the Witkin viewpoint of embeddedness. The field-independence and other embeddedness tests loaded on and defined different factors from the distraction tests. The two factors, however, did tend to be moderately correlated.

The *ability to overcome embeddedness* is currently the accepted interpretation of field independence. It is viewed as the perceptual aspect of the more pervasive analytic-global cognitive style (Kogan, 1971).

The Witkin group has relied on three principal tests to assess field dependence: the *Body Adjustment Test* (BAT), the *Rod and Frame Test* (RFT), and the *Embedded Figures Test* (EFT).

The BAT consists of a tilting chair within a tilting room, the seated subject being required to adjust the chair to true vertical. The subject's score is the deviation of the chair's adjusted position from the true upright. The RFT presents a luminous rod within a luminous frame in a completely dark room. The subject must adjust the rod to the true vertical when the rod and frame are tilted in either the same or opposite directions. The subject's score is the degree of absolute deviation of the rod setting from true upright. The EFT consists of complex geometric patterns in which simple figures are embedded. The subject must locate the embedded simple figures. The amount of time required to do so constitutes the score on the test. Similar to the EFT, and often used in its place, is the Hidden Figures Test (HFT; French, Ekstrom, & Price, 1962). In the HFT, the number of simple figures which are located within complex ones in a fixed length of time constitutes the score.

Although all the tests employed are interpreted as representative of the ability to overcome an embedding context, there appears to be a different rationale for this interpretation among the tests. The BAT and the RFT appear to represent, as in Witkin's original investigations, the ability to use kinesthetic cues to overcome the embedding influence of a visual field. The EFT and the HFT, on the other hand, appear to represent ability to pick specific visual elements out of am embedding visual field. A high level of intertask consistency is reported for BAT, RFT, and EFT for groups ranging in age from eight to twenty-one (Witkin, Goodenough, & Karp, 1967). This is not consistent with the theory of perceptual types postulated by Lowenfeld (1945, 1957). Lowenfeld's theory (see pp. 48-59) clearly separates visuals, who rely on visual imagery to gain information concerning the environment and can both separate and integrate visual details, from haptics, who rely on kinesthetic information and cannot separate or integrate visual details. Thus, the Lowenfeld theory predicts that the individuals who are visually oriented would be tied to the visual field and therefore field dependent on the BAT and RFT, but capable of separating visual detail and therefore field independent on EFT or HFT. The haptic, on the other hand, would be predicted to rely on kinesthetic sensations and therefore field independent on the BAT and RFT, but unable to separate visual detail and therefore field dependent on EFT or HFT. These theoretical predictions are not consistent with Witkin's finding of high intertask correlations. A recent study (Ausburn, L., 1975) does indicate that visuals are more field independent as measured by HFT than haptics. The present study attempts to replicate this finding. The contradiction of theoretical bases discussed here and the different outcomes they predict is suggested as the topic of future research. Both the Witkin and the Lowenfeld theories may have elements not yet discovered.

Stability of field independence over time. The absolute level of field independence has been demonstrated to increase with age up to a certain point. Extensive cross-sectional studies by Colami (1965) and Schwartz and Karp (1967) reveal a tendency toward increasing field independence up through middle age and then a return to relative field-dependence in old age. Bigelow (1971) found that in a cross-sectional study of five- to ten-year-old children the general trend is a movement from relative field-dependence to greater field-independence with increasing age. Both cross-sectional and longitudinal studies by Witkin and his associates (Witkin, 1949; Witkin, Goodenough, & Karp, 1967) show progressive increase in field-independence up to the age of seventeen in boys and fifteen in girls. The longitudinal data for males show no additional increase in field-independence between the ages of seventeen and twenty-four.

A longitudinal analysis (Witkin, Goodenough, & Karp, 1967) indicates that, despite general age-group shifts toward field-independence, the dependence or independence of individuals remains quite stable relative to their peers. It was the finding of this study that:

> ... despite a marked general increase in differentiation in perceptual functioning with age, each individual tends to maintain his relative position among his peers in the distribution of measures of differentiation from age to age (Witkin, Goodenough, & Karp, 1967, p. 291).

Sex differences in field-independence. Sex differences in differentiation apparently appear only at certain ages. Witkin, Goodenough, and Karp (1967) found no difference in field-independence for boys and girls of ages five to eight years. Bigelow (1971) found no sex differences up to ten years of age, while Witkin (1949) found boys to be markedly more field-independent than girls at age eight. In a later study (Witkin, Goodenough, & Karp, 1967), males were found to be more field-independent than females among older children and young adults. These results were expected in view of an earlier study (Witkin, 1950) in which female college students were found to be more field-dependent than male peers.

Because of the relationship between differentiation and tests of spatial ability (see p. 41), Sherman (1967) interprets the frequently-observed greater field-independence of males as indicative of males' superiority in spatial skills. He further attributes male spatial superiority to differential learning opportunities for males and females in the American culture. Maccoby (1966) challenges Sherman's interpretation on the grounds that the play activities of males and females in nursery school are not fundamentally different in spatial character. Stafford (1961) argues against the cultural interpretation of sex differences in differentiation and claims that they can be explained on genetic grounds. An unresolved controversy between Broverman, Klaiber, Kobayashi, and Vogel (1968, 1969) and Singer and Montgomery (1968) over the degree to which sex differences in cognitive abilities can be linked to physiological, hormonal factors has not produced conclusive evidence, and the question still remains to be settled.

Cultural-ethnic differences in field-independence. Black children (Ramirez & Price-Williams, 1974), Mexican-American children (Ramirez & Price-Williams, 1974; Mebane & Johnson, 1970), and children of Eastern European Jewish heritage (Dershowitz, 1971) have all been found to be more field-dependent than Anglo-American children of the same age. The females of each group were found to be more dependent than the males, although this difference is less pronounced among Anglo-Americans than among the other ethnic groups.

Witkin (1967) has hypothesized that cultural differences in field-dependence are related to cultural values reflected in socialization patterns, and that cultures in which such values as stress on conformity, strong traditional dominance, parental authority, group identity, strong family unity, and severity of discipline tend to inhibit the development of field-independence. Witkin's hypothesis is supported by studies (Dershowitz, 1971; Berry, 1966; Witkin, Price-Williams, Bertini, Christiansen, Oltman, Ramirez, & Van Meel, 1974) which have shown that cultural groups which stress traditional social values are more field-dependent than more Americanized groups in which these values are less rigidly enforced, and that members of traditional cultures who have been reared with Americanizing influence are less field-dependent than members of the same culture who have not been subjected to this influence.

Implications and correlates of field-independence. The relationship of field-independence to general intelligence is a matter which is still in question. Most of the relationships between measures of field-independence and verbal intelligence presented by Witkin and his associates (Witkin et al., 1962) are low or non-significant. They did, however, find statistically significant correlations for ten- and twelve-year-olds between field-independence and total IQ on the Stanford-Binet and the WISC. In the latter case, the correlations with the performance IQ exceeded those with the verbal IQ. An unpublished study by Woerner and Levin (Goodenough & Karp, 1961) with twelve-year-olds yielded a significant relationship between field-independence and WISC IQ scores. In a study conducted with adults (Powell, 1964), significant correlations were found between vocabulary scores on the WAIS and two measures of field-independence. Studies such as these, however, are in conflict with others (Sigel, Jarman, & Hanesian, 1963; Bigelow, 1971) in which little or no significant correlation was found between field-independence and intelligence.

In an attempt to shed new light on the issue of the relationship of field-independence to IQ, Goodenough and Karp (1961) conducted a factor-analytic study to determine if certain WISC subtests might be responsible for the relationship to total IQ. The same three factors emerged for ten- and twelve-year-olds. The first factor - verbal comprehension - was distinguished by substantial loadings for the Vocabulary, Information, and Comprehension subtests. The second factor - attention/concentration - showed substantial loadings for Digit Span, Arithmetic, and Coding. The third factor was designated as analytic field approach and had substantial loadings for Picture Completion, Block Design, and Object Assembly. The BAT, RFT, and EFT yielded substantial loadings only on this third factor. This led the Witkin group to conclude that there is a factor which is common to some subtests of intelligence tests and measures of field-independence and which represent the ability to overcome an embedding context. Because field-dependent individuals are likely to score poorly on these subtests of intelligence tests, they may receive a lower over-all IQ score than field-independent peers.

There is little data concerning relationships of field-independence to specific academic abilities and achievement. Although Witkin has consistently claimed that differenciation is independent of verbal and mathematical skills, a few studies contradict this. Crandall and Sinkeldam (1964) and Wachtel (1968) reported significant positive correlations for verbal skills among preadolescents and young adults, respectively. Bieri, Bradburn, and Galinsky (1958) found significant correlations between EFT performance and mathematical ability in college students. Ausburn, Back, and Hoover (1976) found remedial readers at the high school level to be more field-dependent than a similar group of non-remedial readers. There is also evidence (Gardner, Jackson, & Messick, 1960; Podell & Phillips, 1959) that field-independence is related to spatial ability.

Modifiability of field-independence. The Witkin group views field-independence as the cognitive aspect of a deeply ingrained personality factor resulting from cultural influences (see pp. 38-39), possible genetic factors (see p. 38), and early childhood training (Dyk & Witkin, 1965), and therefore highly resistent to training. Direct short-term training in field-independence (Elliott & McMichael, 1963) has, indeed, been unsuccessful. However, indirect experiences such as body rotation (Wolf, 1965) and brief sensory deprivation (Jacobson, 1966, 1968) have resulted in reductions in field-dependence on the RFT. It is hypothesized that such experiences make subjects more aware of bodily sensations and thus better able to analyze physical cues. However, there is no evidence as to whether the observed short-term changes are maintained or whether they are also observable in performance on the more visually-oriented EFT or HFT.

All the attempts located in the research literature to modify differentiation have been attempts to decrease field-dependence and increase field-independence. This seems to imply that there are no advantages to being field-dependent and that field-independence is considered to be a more mature and desireable mode of functioning. However, evidence indicates that field-dependents may be more sensitive to social situations. For example, in tasks requiring the memory of social words (Fitzgibbons, Goldberger, & Eagle, 1965), the memory for faces (Messick & Damarin, 1964), or the reaching of consensus (Wallach, Kogan, & Burt, 1967), field-dependent individuals perform better than field-independents. Whether training in field-dependence would result in improvement in such social skills is at present unknown.

The Leveling/Sharpening Dimension of Cognitive Style

A definition of the dimension. The construct of leveling-sharpening represents the one dimension of cognitive style explicitly concerned with individual differences in memory functioning. It deals with stable differences in the degree to which individuals vary in the ability to retain discrete images of gradually changing, sequentially presented stimuli. Santostefano, who has been a leading researcher in leveling-sharpening, defines the dimension as follows:

> The principle of Leveling-Sharpening concerns the manner in which an individual processes ongoing, changing stimuli. Perceivers who make predominant use of the Leveling principle when processing sequentially occurring stimuli tend to assimilate or merge new experiences with memories of earlier ones and therefore construct relatively undifferentiated impressions of ongoing experiences. When the principle of Sharpening governs cognitive functioning, the perceiver tends to maintain discrete impressions of sequentially presented stimuli so that elements do not lose their individuality (Santostefano, Rutledge, & Randall, 1965, p. 59).

In a more recent statement on leveling-sharpening, Santostefano states that:

> This principle concerns the manner in which an individual perceives and makes adaptive use of gradual changes in sequentially experienced stimuli. Some individuals (levelers) tend to assimilate or merge new experiences with memories of earlier experiences, and therefore, construct relatively undifferentiated and contaminated memories, impressions and imagery of ongoing experiences. Others, on the other hand, tend to maintain discrete impressions and memories of sequentially presented stimuli so that elements do not lose their individuality (sharpeners) (Santostefano, 1971, p. 15).

Research on leveling-sharpening was begun by Klein, who developed the theory of cognitive controls. In his cognitive control approach to perceptual-cognitive functioning, Klein (1951, 1958) postulated that stable individual differences in cognitive functioning represent ego controls or regulators that manage information. This management, he believed, coordinates the individual with environmental demands and opportunities and with internal impulses and motives. He draws a parallel between his model and that of the psychoanalytic concept of ego mechanisms of defense.

Santostefano (1971) states that Klein's theory of cognitive controls has been developed and refined during the past 20 years and presently includes a complex set of propositions and hypotheses. He explains the principal aspects of the theory as follows:

> In most general terms, cognitive controls have the status of intervening variables which define principles by which perception, memory and other basic qualitative forms of cognitive functioning are organized as an individual coordinates himself with his environment. Specifically, cognitive controls are defined as mechanisms or principles which: (1) govern and determine the amount and organization of information which becomes available to an individual perceiver; (2) are activated by specified classes of stimuli which cause the individual to experience some intention to use and adapt to the information; (3) vary in the extent to which they operate in the cognitive functioning of individuals; (4) evolve, in part, as a function of maturation and life experiences and become independent (autonomous) from their origin of development; (5) mediate the influence of personality and motivation in the individual's cognitive encounters with the environment; (6) become enduring aspects of an individual's cognitive functioning and adaptive style and, thus, give shape to his subsequent cognitive experiences (Santostefano, 1971, p. 14).

While recognizing that even the simplest behavior probably involves more than one cognitive control, the Klein group has attempted to identify specific dimensions of control which are observable in the functioning of individuals and which show stability. Over a period of 15 years of research, four such controls have emerged and withstood considerable experimentation, one of which is the principle of leveling-sharpening. Santostefano (1971) points out that the opposite ends of the continua formed by the controls are not conceptualized as qualitatively different. They represent differences of degree, not of type, in managing specific types of information. Klein (1958) has proposed that several cognitive controls may be combined to form a profile representing an individual's cognitive style.

Several instruments have been used to assess leveling-sharpening tendency. The Schematizing Test (Holzman, 1954) requires the subject to make size judgements of squares of projected light as they gradually shift from being the largest in a series to the smallest. Because the Schematizing Test proved difficult to administer to children, Santostefano (1964) developed the Wagon Test, in which eight elements of a wagon can be subtracted or added. A newer test developed by Santostefano (1971), the Leveling-Sharpening House Test, has been used with both children and adults. It consists of 60 pictures of a house in which changes are gradually made which must be identified by the subject. In all tasks used to assess leveling-sharpening, sharpeners are defined as those able to identify changes in sequential material.

Stability of leveling-sharpening over time. Several studies (Gardner & Moriarty, 1968; Santostefano, 1964) have shown that the absolute degree of sharpening tends to increase with age. As with other dimensions of cognitive style, however, the tendency to level or sharpen tends to remain stable when an individual is considered in relation to his own age group (Gardner & Long, 1960a).

Implications and correlates of leveling-sharpening. Only one study (Staines, 1968) was located in which the attempt was made to relate leveling-sharpening to general intelligence. In this study, almost no relationship ($r = .07$) was demonstrated between leveling-sharpening on the Schematizing Test and Otis IQ in a sample of adolescent females.

While Gardner, Jackson, and Messick (1960) found no significant relationships between leveling-sharpening scores and numerous specific intellectual abilities, other studies have revealed some relationships of this type. Staines (1968), for example, found differences between extreme levelers and sharpeners on a number of academic achievement tests. Sharpeners performed better than levelers in English, math, and science. No differences in achievement were observed in foreign languages, history, poetry, and spelling. These results are difficult to understand since the latter fields appear to be as dependent upon memory functions as the former, and Staines offers no explanation for his findings.

Gardner and Long (1960b) found that female sharpeners between the ages of 19 and 36 performed differently from a similar group of levelers on a serial learning task. The subjects were presented with two lists of highly similar words and then asked to recall the words in the order presented. On one of the two lists presented, the sharpeners tended to give more responses and make fewer errors than the levelers. It does not, however, appear that leveling produces a general tendency toward disability in verbal skills. In a study with boys between the ages of eight and thirteen, Santostefano and his associates found no significant difference in leveling and sharpening between children with and without reading disabilities (Santostefano, Rutledge, & Randall, 1965). This suggests that the inability to differentiate ongoing stimulus material does not produce reading disability.

Attempts have been made to demonstrate the existence of general tendencies toward leveling or sharpening by examining differences in performance with material presumably not deliberately committed to memory. Berkowitz (1957) found that after copying and hearing story material, sharpeners of college age had more accurate and detailed recall than levelers. Holzman and Gardner (1960) asked a sample of female college students to recall the story of the Pied Piper, and scored the recalls on the bases of number of story elements included and number of errors committed. Sharpeners recalled more story elements, but there was no significant difference in errors committed. The authors interpreted the results as indicative that the tendency to level or sharpen is general and is apparent in the organization of old memories as well as in the organization of new material presented in laboratory situations. There is, of course, a flaw in studies such as this in that no control can be made for initial learning in childhood. In order to study leveling-sharpening in non-laboratory learning situations of educational relevance, consideration will have to be made of how much variance in contributed by initial exposure and how much by differences in memory functioning. It does, however, seem reasonable that if a large portion of classroom learning involves the receiving of new information and placing it into existing cognitive structures as Ausubel (1963) claims, and if existing cognitive structures are subject to leveling and sharpening as the Holzman and Gardner study (1960) suggests, then leveling-sharpening tendencies may very well influence the learning and retention of meaningful new material. It is suggested that research be conducted to determine if this is indeed the case.

Modifiability of leveling-sharpening. Sharpening is considered to be a more mature and developmentally advanced cognitive functioning than sharpening (Santostefano, 1971). In addition, some studies previously cited have shown that sharpeners perform better in some situations, but no studies could be found which indicated an advantage for levelers. It therefore seems likely that attempts to modify this cognitive control would be attempts to increase sharpening. However, no studies could be located which reported such attempts. Although Staines (1968) states that results of his study lead him to believe that "... levelers would profit from methods of teaching and learning that stress attention to small perceptual differences and changes between stimuli" (p. 126), he offers no empirical evidence of the success of training.

Lowenfeld's Visual-Haptic Perceptual Typology

Theoretical perspective. Research in the area of visual perception deals, in general, with the ways in which visual information is obtained and processed. Theory in visual perception might be divided into two primary schools of thought. One school of thought treats visual perception as a property which is essentially the same for all humans. Theorists of this school conceptualize differences in visual perceptual-cognitive functioning as differences of degree rather than of type. Representative of this viewpoint is Arnheim (1969), who stresses the close ties of visual perception to thought processes and the developmental and trainable nature of visual perceptual skills. A similar theoretical viewpoint is taken by Piaget, who also views visual perceptual functioning as developmental and essentially the same for all individuals, with differences occurring only in degree or developmental level. Piaget views haptic, or non-visual, perception as the ability to translate kinesthetic and tactile impressions into visual imagery and empirically demonstrated this ability to be developmental in children (Piaget & Inhelder, 1956). Piaget postulates two distinct components of haptic perception: (1) the translation of tactile perceptions into visual ones, and (2) the construction of a visual image incorporating the tactile data. It is his contention that in order to learn haptically, a perceiver must form visual images of haptically perceived stimuli (Piaget & Inhelder, 1956).

The views of visual perception represented by Arnheim and Piaget are contrasted by the school of thought represented by Lowenfeld, who stresses the existence of individual differences in the very nature of perceptual-cognitive precesses. Like Arnheim and Piaget, Lowenfeld believes that there is a close link between perception and thought processes and that perceptual skills are developmental. Lowenfeld does not believe, however, that perception is esentially the same process for all individuals, or that the formation of visual imagery is necessary for learning to occur. Instead, he conceptualizes individual differences in perceptual style in terms of a perceptual typology characterized by two distinctly different perceptual types: the visual type and the haptic type. These two types are, according to Lowenfeld, entirely different in their reaction to and processing of visual stimuli.

Lowenfeld's typology. The visual-haptic perceptual typology was developed by Lowenfeld in extensive research in art education in the United States and Austria. The major criticism of his work has been his lack of empirical validation of his theory. Work by later researchers, however, has helped to accomplish this validation.

In his early work, Lowenfeld (1939) found what he believed to be two distinct creative types, based on two unlike types of perception of and reaction to the world of experiences. Somewhat later, he conducted studies which led him to believe that "the distinction which is true for creative types can also be made among individuals" (Lowenfeld, 1945, p. 100). He claimed that there existed two distinct perceptual types, which he called the visual type and the haptic type, and developed a battery of tests through which perceptual type may be identified for individuals (Lowenfeld, 1945).

Lowenfeld conceptualizes his two perceptual types as the opposite ends of a continuum. The types refer to modes of perception and organization of the external environment. He identifies an individual of the visual perceptual type as one who uses the eyes as the primary sensory intermediaries for sense impressions. The visual type learns through visual imagery. An extremely visually minded person is "entirely lost in the dark and depends completely on ... visual experiences of the ... world" (Lowenfeld, 1957, p. 263) and would be "disturbed and inhibited if ... limited to haptic impressions, that is, if ... asked not to use sight but to orient himself only by means of touch, bodily feelings, muscular sensations, and kinesthetic functions" (Lowenfeld & Brittain, 1970, p. 234). The visual type is perceptually an observer, usually approaching things from their appearance, acquainting self with environment via the eyes, relating to experiences as a spectator, and transforming kinesthetic and tactile experiences into visual ones (Lowenfeld, 1957).

According to Lowenfeld, the haptic type is normally-sighted, but, in contrast to the visual, relies not on the eyes as primary sensory intermediaries, but rather on the "body-self": muscular sensations, kinesthetic experiences, tactile impressions, and other physical sensations to acquaint self with environment. The haptic type is primarily a subjective type who tends to "feel" experiences rather than see them. The haptic does not transform kinesthetic and tactile experiences into visual ones, but is content with the tactile or kinesthetic modality itself. This means that learning does not occur for the haptic through visual imagery (Lowenfeld, 1957).

The tests developed by Lowenfeld (1945) for identifying individuals of the two perceptual types are based on several theoretical distinctions between them:

1. While the visual has the ability to see a whole, break it up and see its component details, and then resynthe-

size the details into a whole; the haptic is unable to do this.

2. While the visual tends to react to stimuli as a spectator and to "see" experiences, the haptic tends to react emotionally, to "feel" stimuli, and to place self into a situation.

3. While the visual has the tendency and ability to visualize and integrate tactile and partial experiences, the haptic has neither this tendency nor ability.

4. While the visual has the ability to maintain visual imagery mentally, the haptic is unable to do this.

Research supporting Lowenfeld's typology. Some research done by Lowenfeld himself can be offered in support of his visual/haptic theory. In his initial study (Lowenfeld, 1939) he simply observed, while working with the partially blind, that some individuals would use the limited sight they had to examine objects or to express themselves in clay modeling, while others would not use their eyes at all, but were content to use the sense of touch. This observation led him to theorize that some individuals who had a limited amount of vision available to them preferred to utilize it, while others actually preferred the haptic modality. He also noticed differences in the art produced by these two types of individuals.

As evidence of visual and haptic perception and expression of the environment, Lowenfeld offers comparative examples of creative works of art. One such comparison made by Lowenfeld is illustrated by the paintings shown in Figure 2, which appears in Appendix F. Painting A, "Street Scene" by a visual adolescent, shows stress on the visually-dominated, externally-directed aspects of light and shadow, proportion, and perspective. Painting B, "Lying on the Bed" by a haptic adolescent, illustrates the haptic internally-directed tendency to focus environment subjectively around self and the subjective use of proportion (Lowenfeld, 1957). A second comparison of visual and haptic expression is made by Lowenfeld based on the drawings shown in Figure 3, which also appears in Appendix F. Although both drawings are interpretations of the same subject, their approach is entirely different. In the visual drawing (A), concern is shown for correct proportions and measurements, lights and shadows, and three-dimensional quality. These are elements discovered by the eyes through objective, externally-directed observation. In contrast, the haptic drawing (B) shows a subjective, internally-directed use of the human body, proportion, and shading to express emotions rather than visual reality (Lowenfeld & Brittain, 1970).

Other researchers have observed differences in creative expression which parallel Lowenfeld's observations for his typology. Drewes (1958) found that the Rorschach responses of a group he designated as "visualizers" (see page 55) tended to be whole and three-dimensional, while "nonvisualizers" produced more kinesthetic responses. Flick (1960) found that both haptic expression, defined as finesthetic, subjective, and internally-directed, and visual expression, defined as sight-oriented, objective, and externally-directed, could be found in literature as well as art. Zawacki (1956) found that haptics tend to relate material in terms of details of emotional significance while visuals do not.

One of the basic tenets of Lowenfeld's theory is that the mental formation of visual imagery is not necessary to the learning process. He uses the term haptic to mean a mode of perception and cognition which is not dependent on visual imagery and in which kinesthetic and tactile impressions are not translated into visual ones. This is in contradiction to the viewpoint of Piaget, who believes that learning must involve visual image formation and defines haptic perception as the translation of kinesthetic and tactile impressions into visual ones. Lowenfeld's position is supported by a study conducted by Gottesman (1971) in which congenitally blind children, totally unfamiliar with visual imagery, were compared with sighted children. Two groups of sighted children and one group of congenitally blind children were given three-dimensional shapes to experience tactually only. One sighted group was then asked to match the shapes they had felt from four figures in a visual display. The second sighted group and the blind group were asked to respond tactually by identifying the shapes by touch. Gottesman found no difference between any of the groups. This appears to confirm the existence of direct tactile-to-tactile learning by the congenitally blind children and possibly by some of the sighted ones. Although it cannot be known whether sighted children using tactile impressions only were mentally forming visual images of the shapes, it is doubtful that congenitally blind children were doing so.

Lowenfeld has contended that perceptual type is linked to innate physiological characteristics. Some support for this contention comes from a relatively new line of research, begun in the 1950's, on lateralization of the human brain. Lateralization studies (Nebes, 1975; Krashen, 1975; Gazzaniga, 1975; Debes, 1975) have shown that the right hemisphere of the brain is dominant in processing visual information, and the left hemisphere is dominant in the verbal domain. This raises the possibility that some individuals may be more right-dominant, and thus more visually oriented, than others.

Further support for Lowenfeld's contention that visual and haptic perceptual style is linked to physiological sources comes from studies using an electroencephalograph (EEG). In a study by Drewes (1958), the brain alpha rhythms of subjects were recorded as they attempted to mentally visualize and manipulate geometric figures to form various combinations on a table top. Since alpha rhythm typically ceases when a visual image is seen or when one is induced mentally by suggestion, Drewes concluded that those individuals who recorded persistent alpha rhythms were not forming visual images, while those who recorded no alpha rhythms were constantly producing mental imagery. Based on alpha rhythm recordings, he divided his subjects into three types: visualizers, nonvisualizers, and responsives. He also recorded Rorschach responses for these groups, and found that the responses of those he had identified as visualizers tended to be whole and three-dimensional forms, while those of nonvisualizers tended to be more kinesthetic and non-visual in nature.

A second EEG study of alpha rhythms was conducted by Walter (1963). Walter explains that alpha rhythms are typically promìnant when the eyes and shut and the mind at rest, and disappear when the eyes are opened, when visual imagery is either seen or induced mentally, and when the subject makes a mental effort. He observed, however, that some individuals produced either virtually no alpha rhythm or, at the other extreme, almost constant alpha. He reports research which shed new light on these individual differences:

> ... in the course of war service at the Burden Neurological Institute ... we were able to designate some of these exceptions as a stable group with definite characteristics. It was shown in 1943 that individuals with persistent alpha rhythms which are hard to block with mental effort, tend to auditory, kinaesthetic or tactile perceptions rather than visual imagery (Walter, 1963, p. 214).

Having discovered a relationship between alpha rhythm and perceptual modality preference and functioning, Walter identified three types of individuals:

1. a type with persistent alpha activity, called the P type,

2. a type with responsive alpha rhythm, called the R type, and

3. a type with no significant alpha rhythm, called the M type, whose "thinking processess are conducted almost entirely in terms of visual imagery" (Walter, 1963, p. 215).

Figure 4, which appears in Appendix F, shows the alpha patterns of each of Walter's types as recorded by an EEG. Alpha waves are represented by short, rapidly-fluctuating lines.

Walter's description of his three types is quite similar to Lowenfeld's conceptions of visuals, haptics, and indefinites in his own typology:

> When a solution or decision of any kind can be reached by visualizing it, the performance of the M type is rapid and precise; but when they are faced with a problem of an abstract kind, or one in which the mental pictures required are too elaborate for them, they become sluggish and confused. On the other hand, at the other extreme, the ... P group ... do not use visual images in their thinking unless they are obliged to do so. Even then, their mind's eye is almost blind; they think in abstract terms, or in sounds or movements; they may even have to 'feel' their way out of an imaginary maze. The R group, the responsives, ... are intermediate between the other two groups; while they do not habitually use private pictures for their everyday thinking, they can evoke satisfactory visual patterns when necessary. Moreover, they can combine data from the various sense organs more readily than can either the M or P types (Walter, 1963, p. 217).

Walter's statement that "evidence already available ... strongly suggests that the alpha rhythm characters are inborn and probably hereditary" (Walter, 1963, p. 218) indicates his support for Lowenfeld's premise that perceptual type is linked to innate physiological traits.

Distribution of perceptual types. In tests involving over 1100 subjects from numerous sex and age groups, Lowenfeld (1945) found that, although most individuals fall between the extremes of his typology, about 75% show appreciable tendency toward either the visual or haptic perceptual type. He reported the following distribution: visuals, 47%; haptic, 23%; indefinite, 30%. Rounding to allow for measurement error, he postulated the following theoretical distribution of perceptual types: visual, 50%; haptic, 25%; indefinite, 25%.

Distributions reported by Drewes and Walter in their EEG studies of alpha waves, while not identical to Lowenfeld's, are somewhat similar. Drewes (1958) found the following distribution: visualizers, 25%; nonvisualizers, 25%; responsives, 50%. Walter (1963) found about two-thirds of his 600 subjects to be R type, while the remaining one-third were about evenly split between the M and P types. In recent studies (Ausburn, L., 1975; Ausburn, F., 1975), Lowenfeld's distribution of perceptual types has been obtained in research involving college students, thus lending support to the postulated distribution.

<u>Visual-haptic aptitude as a learning and instructional variable</u>. Only a few studies have been conducted to determine the relationship of perceptual type to scholastic achievement. Erickson (1964, 1966) found that students of the visual type show superior performance in mechanical drawing. In a later study, Erickson (1969) found the mean level of reading achievement for haptic students to be one-half to one full grade level below that of visual students. Similarly, Templeman (1962) found that visual children learned to read faster than haptic children. Bruning (1974) found significant positive correlations between visual aptitude as defined by Lowenfeld and achievement in both reading and mathematics for high school students.

Virtually no studies have been conducted to investigate instructional methods which interact with visual and haptic perceptual types. In the only study of this type which was located (Ausburn, F., 1975), it was found that multiple imagery resulted in superior performance over linear imagery in the presentation of a task in which subjects had to compare visual elements in a sequence of three pictures and then locate a specific item in a fourth picture. With multiple imagery, performance was significantly better in terms of both accuracy and latency. While both visuals and haptics were benefitted by the use of multiple imagery, it was found that the greater benefit occurs for haptics. It was the conclusion of the study that the simultaneity of visual images inherent in multiple imagery supplanted, or performed for the learners, the psychological task of retaining visual images for comparison. Since this process is especially difficult for haptics, they were benefitted most by the use of multiple imagery.

Interrelationships among Cognitive Style Factors

Several interrelationships can be readily seen among the cognitive style variables which are the focus of this study. On a simple level, several similarities appear among the variables. All four of them, for example, show a tendency to be developmental in an absolute sense and yet stable over time in a relative sense. It has been demonstrated empirically in research previously cited that individuals tend to increase in absolute degree of reflectivity, field independence, and sharpening with age, but to remain stable in relationship to age-group peers. Although Lowenfeld did not document it empirically, he postulated a similar nature for his visual and haptic perceptual types.

A second area in which similarity appears among the variables is lack of relationship to general intelligence.

Lowenfeld made no mention of relationship between intelligence and perceptual type, nor has any been demonstrated by later researchers. No relationship has been reported between leveling/sharpening and any measure of intelligence. The apparent correlations between both reflectivity/impulsivity and field independence/field dependence and general intelligence now appears to be confined to certain subtests of IQ instruments which contain elements of response uncertainty and embeddedness, respectively. All four variables have, however, been related to specific academic abilities and achievement.

A final similarity shared by the variables under discussion is a resistance to modifiability. Successful modifiability of cognitive tempo has been confined to an alteration of response time only; no effect of training on error rate has been observed. Direct short-term training in field independence has also been unsuccessful, and indirect attempts at modification of field dependence have yielded only short-term changes. Witkin views field independence as part of a deeply ingrained personality structure and therefore highly resistent to modification. The tendency toward leveling or sharpening has not been the subject of modification attempts as yet, but evidence indicating that it is a general characteristic and appears in the organization of old memories as well as new laboratory situations suggests it is deeply ingrained and probably resistent to alteration. Lowenfeld offered no empirical evidence concerning the modifiability of perceptual type, but he views it as a characteristic which is related to personality and the entire perceptual-cognitive structure of the individual and therefore highly resistent to alteration. Electroencephalographic data relating perceptual type to electrical patterns in the human brain also suggest an innate and therefore basically unmodifiable nature of the trait.

In addition to these simple similarities, several more complex interrelationships can be observed among the variables of this study and the tasks used to assess them.

The task used to assess Kagan's reflectivity/impulsivity dimension requires the subject to look at a series of similar variants and identify one which is identical to a standard. This task requires the separation of visual detail from a field, which relates it both to Witkin's field independence dimension and to the Lowenfeld perceptual typology. Were it not for research (see p. 22) which indicates that the tendency toward reflectivity or impulsivity is consistent over a variety of tasks involving response uncertainty, there might be considerable temptation to attribute an impulsive tempo as much to lack of ability to discriminate and separate visual detail as to lack of regard for errors when responding. The fact that many of the tasks involving response uncertainty used in the studies on the stability of tempo also involved visual stimulus material does not offer much help in resolving this issue. Studies indicating that response time is more easily modified than is error rate (see pp. 27-28) also fail to offer conclusive evidence. It may be that lack of concern for errors causes failure to analyze all response possibilities even if longer response time is used, or it could be that lack of ability to separate visual details -

related to field dependence or a haptic perceptual style - causes a high error rate even if adequate time is taken before responding. Kogan's (1971) statement, cited previously, that "the reduction of error rates evidently requires specific training in scanning visual arrays" (p. 269) suggests that he perceives a relationship, as yet not investigated, between visual perceptual functioning and performance on the standard cognitive tempo assessment task. This potential relationship is investigated in the present study.

The conceptual relationship between the field independence/field dependence construct and Lowenfeld's visual/haptic perceptual typology appears intuitively to be strong. The field independent ability to overcome the embeddedness in a visual field which is measured by the EFT or HFT appears to be directly related to the ability to separate and analyze visual details which is postulated as a principal characteristic of the visual perceptual type. Such a relationship was, in fact, found in an earlier study by the author (Ausburn, L., 1975), and is attempted to be replicated in the present study. What is troublesome in relating the Witkin and Lowenfeld perceptual dimensions is the contradiction of predicted outcomes which arises if the theories of both researchers are applied to the BAT and RFT instruments for assessing field independence (see pp. 35-36). The use of kinesthetic cues to overcome the embedding context of a visual field postulated by Witkin to account for field independent performance on these tasks is not consistent with Lowenfeld's concept that the visual individual is likely to gain information from visual cues rather than kinesthetic ones. In Lowenfeld's terminology, Witkin views field independence as a function of visual perceptual functioning in the case of the HFT or EFT, but of haptic functioning in the case of the BAT and RFT, resulting in both cases in field independence, or the ability to overcome embeddedness. It can be predicted from Lowenfeld's view, however, that the visual type would separate visual detail and perform in a field independent manner on the former tests, but would remain visually rather than haptically oriented and thus perform in a field dependent manner on the latter two tests. The high intertask correlations reported by Witkin for his tasks (see p. 35) lends support for his interpretations, but it is possible that some other factor as yet undiscovered accounts for these correlations.

A question which arises concerning the relationships among the memory-oriented leveling/sharpening dimension and the Witkin and Lowenfeld theories concerns the amount of variance on the leveling/sharpening variable which might be related to field dependent or haptic perceptual functioning rather than to memory functioning. It is possible that at least some degree of apparent leveling might be demonstrated due to lack of ability to quickly perceive the details of a visual array initially rather than to a lack of differentiation of them in memory. It is hoped that the findings of the present study will shed some light on this question.

CHAPTER III

METHODOLOGY

This study is an investigation of relationships among cognitive style variables. This chapter outlines the methodology used to conduct the investigation.

Subjects for the Study

The subjects for the study were a group of 206 undergraduate students enrolled in Education 4160, Media and Technology in Teaching, at the University of Oklahoma. All subjects were volunteers, ranging in age from 19 to 33 years. There was a total of 12 subjects from racial minorities. The sample contained 144 females and 62 males.

Testing Instruments Used

The instrument used to assess perceptual type as defined by Lowenfeld was Successive Perception Test I (United States Army Air Corps, 1944), a test in motion picture form which was developed by Gibson for use in the World War II Aviation Psychology Program as a part of the pilot selection and training program. Successive Perception Test I (SPT-1) is a refined version of Lowenfeld's original Integration of Successive Impressions (Lowenfeld, 1945), and is based on the same rationale and construct. The primary distinction between individuals of the visual and haptic perceptual types which serves as the basis for both the Lowenfeld test and for SPT-1 is that while visuals have the tendency and ability to integrate partial perceptions into visual wholes, haptics are content to internalize the separate segments of partial impressions and show neither tendency nor ability to integrate them into whole units.

SPT-1 consists of three practice items and 35 actual test items. In each item, the subject views a pattern a small section at a time behind a moving slot and is then shown five similar variants from which must be selected the one which matches the pattern seen behind the slot.

SPT-1 was developed originally for use in the Army Air Corps cadet program and has been used extensively in that context. It has also been used numerous times in educational research dealing with perceptual type and visual aptitude with subjects ranging from seventh grade to university level (Erickson, 1966, 1969; Clark, 1971; Bruning, 1974; Ausburn, L., 1975; Ausburn, F., 1975). The test-retest reliability of SPT-1 was computed by Ausburn (F., 1975), using 80 subjects and a test-retest interval of six weeks, to be .68. While this reliability coefficient is rather low, the test has yielded research results consistent with theory-based hypotheses. In addition, SPT-1 is the only currently available instrument for assessing perceptual type for which reliability has been established empirically.

The <u>Hidden Figures Test</u> (HFT; French, Ekstrom, & Price, 1963) was used to assess field independence/field dependence.

The HFT, developed for research purposes as part of the <u>Kit of Reference Tests for Cognitive Factors</u> by Educational Testing Service, is cited by Kogan (1971) as an alternate test to Witkin's frequently used <u>Embedded Figures Test</u> (EFT). Like the EFT, the HFT is confined to the visual perception aspect of field independence, measuring the trait in terms of ability to overcome the embedding context of a visual field by locating a simple geometric figure within a complex one. However, while the dependent measure in the EFT is the time required to locate the embedded figures, the dependent measure in the HFT is the number of figures located within a specified time. The HFT has the practical advantage of being a group instrument rather than an individual one. Since no reliability coefficient for the HFT could be located, it was computed by the test-retest method using 60 subjects and a time interval of 12 weeks, and was found to be .92.

Reflectivity/impulsivity was measured with the adult form of Kagan's (1969) <u>Matching Familiar Figures</u> (MFF). While a specific reliability coefficient could not be located for MFF, the instrument is the standard one used in research on cognitive tempo. Kagan (1966a) calls it the "most sensitive" measure of cognitive tempo, and Kogan (1971) states that it is "now consistently employed as the basic index" of the trait (p. 266). On this basis, it was accepted for use in the present study.

In the MFF, the subject must examine a standard in the form of a black and white line drawing of a figure (such as a lion, a bed, a flower, etc.) and then look at a series of similar variants and select the one which is identical to the standard. The standard remains in the subject's view at all times, thus eliminating memory as a variable. The adult form of MFF consists of 12 items with eight variants per item. Dependent measures obtained on the test are response latency and number of errors on each item. These two variables show a negative correlation for all age groups ranging in magnitude from the low .40's to the high .60's (Kogan, 1971).

The instrument used to assess leveling/sharpening was Santostefano's (1971) Leveling-Sharpening House Test (LSHT). This test consists of 60 black line drawings of a scene containing a two-story house with windows, a door, a weathervane, a chimney, a sidewalk, a fence, a cloud, a tree, and a sun. The intact picture is displayed three times. Then one element (the door knob) is omitted, and the picture is again shown three times. An additional element is omitted every three trials until a total of 19 elements are omitted from the original display, with the least conspicuous element eliminated first and the most conspicuous last. Each picture is displayed for five seconds. The subject is asked to tell the test administrator when something looks different from the previous picture. This task yields three measures. The "first stop score" indicates the point at which the subject first correctly reports that something is different. Early detection reflects sharpening. A high total number of correct changes reported also reflects sharpening. A "leveling-sharpening ratio", the third dependent measure, reflects a mean number of changes which go undetected.

The smaller this ratio, the greater the operation of sharpening.

Santostefano (1971) reports that LSHT has been used for research purposes with children from ages four through adolescence ans with adults. He reports no reliability coefficient for the test, so test-retest reliability was computed as part of the present study using 30 subjects and a time interval of five weeks. It was found to be .86. However, Santostefano (1971) states that extensive research is being conducted concerning the reliability of LSHT, and this data, when released, will be far more conclusive than that reported here. He states that at this time the test is being "made available to those professionals interested in including the procedure in their clinical research work on an experimental basis" (Santostefano, 1975, p. 2), and it was primarily on this basis that it was accepted for use in the present study.

Procedures

The 206 subjects were administered SPT-1 via a video tape made from the black and white motion picture version in groups ranging in size from 21 to 38 persons. They were asked to indicate their response on each test item by circling the appropriate letter on an answer sheet such as the one shown in Appendix A. The subjects were classified as visual, haptic, or indefinite in perceptual type according to procedures developed by Lowenfeld (1945) for his Integration of Successive Impressions. Subjects scoring 60% or more items correct (scores of 21 - 35) were classified as visual, while those scoring 60% or more incorrect (scores of 0 - 14) were classified as haptic.

The HFT was given to the subjects in the same groups and at the same sitting as the administration of SPT-1. It was administered and scored according to procedures given in the test manual provided with the test (French, Ekstrom, & Price, 1963). Responses were indicated on the test forms by placing a mark through the letter of the simple figure located in each complex one. The score made on the test was computed by subtracting, as a correction for guessing, one-fourth of the number of items answered incorrectly from the total number of items answered correctly. Items for which no response was made were not counted as either correct or incorrect. Subjects scoring in the upper one-third of the sample were classified as field independent; those scoring in the lower one-third were classified as field dependent. Table 1 shows the number of subjects classified and the score ranges included in each classification. The unequal group sizes were caused by tied scores at the cut-off points.

The MFF was administered to subjects individually and was scored according to procedures developed by Kagan (1966a). The examiner's instructions to the subject are shown in Appendix B. The response latency and number of errors made on each of the 12 test items were recorded on a score sheet such as the one shown in Appendix C. The error total and mean response latency were computed for each subject, and median error (M = 3.0) and latency (M = 64.66) scores for the entire sample were calculated. Subjects scoring above median latency and below median errors

Table 1

Subject Classification on HFT

Classification	Number Classified	Score Range Included
Field Independent	76	27 to 13
Indefinite	57	12.5 to 6.5
Field Dependent	73	6 to -2

were classified as reflective; those scoring below median latency and above median errors were classified as impulsive.

The LSHT was administered to the subjects individually during the same testing period as the MFF. It was administered using test forms and instructions contained in the test manual (Santostefano, 1971). The examiner's instructions to the subject are shown in Appendix D. The leveling-sharpening ratio was computed for each subject according to instructions in the test manual. Subjects whose ratio was in the lower one-third of the sample were classified as sharpeners; those whose ratio was in the upper one-third were classified as levelers. Table 2 shows the number of subjects classified and the leveling-sharpening ratio ranges included in each classification.

Table 3 summarizes the testing instruments and classification procedures used and the number of subjects classified on each instrument. Appendix E shows the raw data for the 206 subjects on all instruments.

Table 2

Subject Classifications on LSHT

Classification	Number Classified	Range of Leveling-Sharpening Ratios Included
Sharpeners	69	6.16 to 11.47
Indefinite	68	11.53 to 14.63
Levelers	69	14.68 to 23.26

Since much of the planned data analysis was to be based on Lowenfeld's theoretical distribution of visual (50%), indefinite (25%), and haptic (25%) perceptual types, a chi-square test for goodness-of-fit using the following formula:

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

was performed to verify that the obtained distribution of perceptual types (visuals = 48%; indefinites = 25%; haptics = 27%) was not significantly different from the theoretical one. The results of the chi-square test are summarized in Table 4.

Statistical Design

The analysis of the data obtained in this study was performed in three major stages. In the first stage of analysis the frequencies of visual, haptic, and indefinite perceptual

Table 3

Subject Classifications on Testing Instruments

VARIABLE AND INSTRUMENT	CLASSIFICATION PROCEDURE	NUMBER CLASSIFIED
Perceptual Type (Measured by SPT-1)	Visual (60% or more items correct)	99
	Indefinite (neither 60% correct nor 60% incorrect)	52
	Haptic (60% or more items incorrect)	55
Field Independence/ Field Dependence (Measured by HFT)	Field Independent (upper 1/3 of the sample)	76*
	Indefinite (middle 1/3 of sample)	57
	Field Dependent (lower 1/3 of sample)	73
*Unequal groups caused by tied scores at cut-off points		
Reflectivity/Impulsivity (Measured by MFF)	Reflective (above median latency and below median errors)	74
	Impulsive (below median latency and above median errors)	75
	Not Classified (at or below median latency and errors OR at or above median latency and errors)	57
Leveling/Sharpening (Measured by LSHT)	Sharpeners (L-S ratio in lower 1/3 of sample)	69
	Indefinite (L-S ratio in middle 1/3 of sample)	68
	Levelers (L-S ratio in upper 1/3 of sample)	69

types obtained in field independent, field dependent, reflective, impulsive, sharpening, and leveling groups was compared with

Table 4

Chi-Square Test for Goodness-of-Fit on Obtained and Expected Distributions of Perceptual Types

PERCEPTUAL TYPE	EXPECTED N	OBTAINED N
Visual	103	99
Indefinite	51.5	52
Haptic	51.5	55

TOTAL N = 206

df = 2

χ^2 = .398*

*$p > .80$

Lowenfeld's theoretical distribution using chi-square tests for goodness-of-fit. This analysis served to test hypotheses one through six.

In the second stage of analysis, the ability of the cognitive style measures of score on SPT-1, score on HFT, errors on MFF, mean latency on MFF, and leveling-sharpening ratio on LSHT to predict or discriminate between visual and haptic perceptual types was examined with a step-wise discriminant analysis. This procedure tested hypothesis seven.

Finally, relationships among the variables of the study were further explored through the use of factor analysis.

CHAPTER IV

STATISTICAL ANALYSIS OF THE DATA

Test of Hyrotheses 1 through 6

In the first stage of data analysis, the following hypotheses were tested with chi-square tests:

H_{01}: There is no difference between the obtained and expected frequencies of visual and haptic types among field dependent subjects.

H_1: The obtained frequency of visual types among field dependent subjects is smaller than the expected frequency.

H_{02}: There is no difference between the obtained and expected frequencies of visual and haptic types among field independent subjects.

H_2: The obtained frequency of haptic types among field independent subjects is smaller than the expected frequency.

H_{03}: There is no difference between the obtained and expected frequencies of visual and haptic types among reflective subjects.

H_3: The obtained frequency of haptic types among reflective subjects is smaller than the expected frequency.

H_{04}: There is no difference between the obtained and expected frequencies of visual and haptic types among impulsive subjects.

H_4: The obtained frequency of visual types among impulsive subjects is smaller than the expected frequency.

H_{05}: There is no difference between the obtained and expected frequencies of visual and haptic types among sharpening subjects.

H_5: The obtained frequency of haptic types among sharpening subjects is smaller than the expected frequency.

H_{06}: There is no difference between the obtained and expected frequencies of visual and haptic types among leveling subjects.

H_6: The obtained frequency of visual types among leveling subjects is smaller than the expected frequency.

Chi-square tests computed on the field dependent, field independent, reflective, impulsive, sharpening, and leveling groups identified by the testing instruments utilized allowed the rejection of all six of the above null hypotheses and the acceptance of the six alternate hypotheses at the .001 level of significance. The results of the chi-square tests are summarized in Tables 5, 6, 7, 8, 9, and 10. The critical value for chi-square at the .001 level of significance with two degrees of freedom is 13.815.

Table 5

Chi-Square Test of Goodness-of-Fit on Obtained and Expected Distributions of Perceptual Types among Field Dependent Subjects

PERCEPTUAL TYPE	EXPECTED N	OBTAINED N
Visual	36.5	8
Indefinite	18.25	23
Haptic	18.25	42
		TOTAL N = 73
		df = 2
		$\chi^2 = 54.41$*

*$p < .001$

Table 6

Chi-Square Test of Goodness-of-Fit on Obtained and Expected Distributions of Perceptual Types among Field Independent Subjects

PERCEPTUAL TYPE	EXPECTED N	OBTAINED N
Visual	38	67
Indefinite	19	4
Haptic	19	5

TOTAL N = 76
df = 2
$\chi^2 = 44.28$*

*$p < .001$

Table 7

Chi-Square Test of Goodness-of-Fit on Obtained and Expected Distributions of Perceptual Types among Reflective Subjects

PERCEPTUAL TYPE	EXPECTED N	OBTAINED N
Visual	37	53
Indefinite	18.5	15
Haptic	18.5	6

TOTAL N = 74
df = 2
$\chi^2 = 16.03$*

*$p < .001$

Table 8

Chi-Square Test of Goodness-of-Fit on Obtained and Expected Distributions of Perceptual Types among Impulsive Subjects

PERCEPTUAL TYPE	EXPECTED N	OBTAINED N
Visual	37.5	16
Indefinite	18.75	21
Haptic	18.75	38

TOTAL N = 75
df = 2
χ^2 = 32.36*

*p < .001

Table 9

Chi-Square Test of Goodness-of-Fit on Obtained and Expected Distributions of Perceptual Types among Sharpening Subjects

PERCEPTUAL TYPE	EXPECTED N	OBTAINED N
Visual	34.5	54
Indefinite	17.25	12
Haptic	17.25	3

TOTAL N = 69
df = 2
χ^2 = 24.39*

*p < .001

Table 10

Chi-Square Test of Goodness-of-Fit on Obtained and Expected Distributions of Perceptual Types among Leveling Subjects

PERCEPTUAL TYPE	EXPECTED N	OBTAINED N
Visual	34.5	11
Indefinite	17.25	21
Haptic	17.25	37

TOTAL N = 69
df = 2
$\chi^2 = 39.43$*

*$p < .001$

Test of Hypothesis 7

In the second stage of data analysis, the following hypothesis was tested with a step-wise discriminant analysis:

H_{07}: The cognitive style predictor variables do not discriminate between the criterion categories of perceptual types.

H_7: The cognitive style predictor variables discriminate between the criterion categories of perceptual types.

The cognitive style predictor variables used in the discriminant analysis were score on HFT, errors on MFF, mean latency on MFF, and leveling-sharpening ratio on LSHT. The two criterion categories to be discriminated were visual and haptic perceptual type as measured by SPT-1.

The analysis indicated that, considered individually as single predictors, score on HFT (df = 1,152; F to enter = 115.2803; $p < .001$), errors on MFF (df = 1,152; F to enter = 96.6521; $p < .001$), mean latency on MFF (df = 1, 152; F to enter = 10.0975; $p < .005$), and leveling-sharpening ratio on LSHT (df = 1,152; F to enter = 10.0948; $p < .005$) were each significant predictors of visual and haptic perceptual type.

Since it was the best single predictor of the perceptual type dichotomy, score on HFT was the first variable entered into the four-variable prediction system. The prediction of perceptual type from this single variable alone was, of course, significant beyond the .001 level as shown by the F value reported above for HFT. Table 11 shows the number of cases classified into the criterion groups with only this single variable entered into the prediction system.

Table 11

Number of Cases Classified into Criterion Groups with HFT Entered

	(CLASSIFIED)	
(OBSERVED)	VISUAL	HAPTIC
VISUAL	89	10
HAPTIC	10	45

Percentage of cases correctly classified=87.01%

The second variable entered was errors on MFF. This variable added significantly to the prediction system, as indicated by the value of its F to remove (df = 1,151; F to remove = 44.2962; $p < .001$). With two variables entered (score on HFT and errors on MFF), the prediction system remained significant beyond the .001 level (df = 2,151; F = 96.20659; $p < .001$). Table 12 shows the number of cases classified into the criterion groups with two variables entered into the prediction system. It can be seen by comparing Tables 11 and 12 that the prediction accuracy gained by adding the second variable was gained in predicting the occurrence of visual types rather than haptic ones.

Table 12

Number of Cases Classified into Criterion Groups with HFT and Errors on MFF Entered

	(CLASSIFIED)	
	VISUAL	HAPTIC
(OBSERVED)		
VISUAL	93	6
HAPTIC	12	43

Percentage of cases correctly classified = 88.31%

The third variable entered was leveling-sharpening ratio on LSHT. With three variables entered, the over-all prediction system remained significant beyond the .001 level (df = 3,150; F = 64.64581; $p < .001$), but the newly-added variable made no significant new contribution (df = 1,150; F to remove = 1.2305; $p > .25$). Table 13 shows the number of cases classified into the criterion groups with three variables entered into the prediction system.

Table 13

Number of Cases Classified into Criterion Groups with HFT, Errors on MFF, and LSHT Entered

(OBSERVED)	(CLASSIFIED) VISUAL	HAPTIC
VISUAL	94	5
HAPTIC	11	44
	Percentage of cases correctly classified = 89.61%	

The reason for the failure of the leveling-sharpening variable to add significantly to the prediction system after the entry of HFT and errors on MFF is seen by examining the correlation coefficients among variables, computed with visual and haptic subjects only with the indefinite perceptual type group removed as it was for the discriminant analysis. While leveling-sharpening ratio on LSHT is modestly but significantly correlated with the criterion variable of score on SPT-1 ($r = -.23$; df = 152; $p = .02$), it is also significantly correlated with both HFT ($r = -.21$; df = 152; $p = .05$) and errors on MFF ($r = .23$; df = 152; $p = .02$). Therefore, although it could be expected to discriminate fairly well between visuals and haptics when considered by itself as a single predictor, leveling-sharpening ratio could not be expected to add significantly to a multi-variable prediction system into which the variables of HFT and errors on MFF had already been entered. It contributes nothing significant which was not already accounted for by the two previously-entered variables because of its correlation with them.

The last variable entered into the prediction system on the discriminant analysis was mean latency on MFF. The over-all prediction system remained significant when this final variable was added (df = 4,149; F = 48.25345; $p < .001$), thus allowing the rejection of null hypothesis seven and the acceptance of the alternate hypothesis. The variable made no significant new contribution to the system, however (df = 1,149; F to remove = 0.1610; $p > .25$). The reason for this is that while mean latency on MFF is correlated with the criterion variable of perceptual type as measured by SPT-1 ($r = .2559$; df = 152; $p = .01$), it is also highly correlated with errors on MFF ($r = -.5888$; df = 152; $p < .01$), which was already entered into the system, and therefore added no significant prediction power not already contributed by the latter variable. Table 14 shows the number of cases classified into the criterion groups with all four predictor variables entered into the prediction system.

Factor Analysis

In the final stage of data analysis, relationships among the variables of the study were further explored with a factor analysis. Table 15 shows the correlation matrix on which the generated factor matrix was based.

Table 14

Number of Cases Classified into Criterion Groups with HFT, Errors on MFF, LSHT, and Mean Latency on MFF Entered

	(CLASSIFIED) VISUAL	HAPTIC
(OBSERVED)		
VISUAL	94	5
HAPTIC	12	43

Percentage of cases correctly classified = 88.96%

Table 15

Correlation Matrix for All Variables

	SPT-1	HFT	MFF ERRORS	MFF LATENCY	LSHT
SPT -1	1.000	.575***	-.540***	.240**	-.226*
HFT		1.000	-.367***	.012	-.179
MFF ERRORS			1.000	-.596***	.189
MFF LATENCY				1.000	-.012
LSHT					1.000

*p $<$ .05
**p $<$ .02
***p $<$ .01

From the correlation matrix shown in Table 15, a two-factor factor matrix was generated. Table 16 shows the factor matrix rotated to Varimax criterion. The Varimax rotation criterion for orthogonal factor rotation maximizes the sum of each of the factor loadings raised to the fourth power. This assures that both large and negligible loadings will be obtained as long as test clusters are orthogonal to each other and provides the best over-all factor loadings. The Varimax rotation criterion is judged by Guertin and Bailey (1970) to produce as good a factor solution as can be expected in an orthogonal frame of reference.

Table 16

Factor Matrix Rotated to Varimax Criterion

	FACTOR I	FACTOR II
SPT-1	.6911	.3024
HFT	.6817	.0639
MFF ERRORS	-.4346	-.6915
MFF LATENCY	.0269	.7076
LSHT	-.2906	-.0487

This factor matrix accounts for 100% of all common variance among the variables and for 45.87% of the total score variance. This can be interpreted as meaning that the factor matrix accounts for all of the variance, given the existing correlation matrix among the variables. It would, however, account for not quite one-half of the score variance if all the variables were perfectly correlated. There thus appears to be considerable specific variance in the individual variables.

Interpreting factor loadings as correlations between the variable and the factor, the variables of SPT-1, HFT, and errors on MFF show substantial loadings on Factor I. LSHT also shows a modest loading on the factor. Factor II is defined by substantial loadings of errors on MFF and latency on MFF, and a modest loading of SPT-1.

CHAPTER V

SUMMARY, DISCUSSION AND CONCLUSIONS, AND RECOMMENDATIONS FOR FURTHER RESEARCH

Summary

A sample of 206 undergraduate volunteers were tested with Successive Perception Test I (SPT-1), the Hidden Figures Test (HFT), Matching Familiar Figures (MFF), and the Leveling-Sharpening House Test (LSHT) in order to assess the cognitive style factors of perceptual type as defined by Lowenfeld, field independence/field dependence as defined by Witkin, reflectivity/impulsivity as defined by Kagan, and leveling/sharpening as defined by Santostefano, respectively. After the subjects were classified on all four instruments, the obtained data was analyzed in three stages.

In the first stage of analysis, chi-square tests were used to compare obtained distributions of visual and haptic perceptual types in the field independent, field dependent, reflective, impulsive, leveling, and sharpening groups with Lowenfeld's theoretical distribution of 50% visuals, 25% indefinites, and 25% haptics. In all cases, the obtained distribution was significantly different from the theoretical one.

In the second stage of data analysis, the four variables of score on HFT, errors on MFF, mean latency on MFF, and leveling-sharpening ratio on LSHT were tested in a step-wise discriminant analysis to determine if they could predict or discriminate between visual and haptic perceptual types. It was found that while the four-variable system could significantly predict perceptual type, a two-variable system composed of score on HFT and errors on MFF could make the prediction with equal accuracy. Latency on MFF and score on LSHT, while sufficiently correlated with the criterion variable to be significant predictors when considered alone, were also sufficiently correlated with the former two variables to fail to add any prediction accuracy not already contributed by them.

In the final stage of analysis, the relationships among the variables of the study were further explored with a factor analysis. The analysis produced a two-factor matrix rotated to Varimax criterion, with SPT-1, HFT, errors on MFF, and LSHT showing substantial to modest loadings on Factor I, and errors on MFF, latency on MFF, and SPT-1 showing substantial to modest loadings on Factor II.

Discussion and Conclusions

Chi-square tests. Lowenfeld's theoretical distribution of perceptual types provides for 50% visuals, 25% indefinites, and 25% haptics in any given population. A significant deviation from this distribution in any population would indicate an occurrence of perceptual types which is different from the predicted and usually occurring one.

Chi-square tests revealed the occurrence of significantly more visuals and fewer haptics than expected in the field independent (88.16% visuals; 6.58% haptics), reflective (71.62% visuals; 8.11% haptics), and sharpening (78.26% visuals; 4.35% haptics) groups. They also revealed significantly fewer visuals and more haptics in the field dependent (10.96% visuals; 57.53% haptics), impulsive (21.33% visuals; 50.67% haptics), and leveling (15.94% visuals; 53.62% haptics) groups. A proportion of visuals to haptics greater than the expected two-to-one ratio in the field independent, reflective, and sharpening groups and a reversal of the expected distribution of visuals and haptics in the field dependent, impulsive, and leveling groups lead to the conclusion that perceptual type is related to the dimensions of cognitive style represented by the groups identified. Visuals tend to display field independence, reflectivity, and sharpening in their cognitive styles, while haptics tend to display field dependence, impulsivity, and leveling tendencies. These results were predicted, as indicated in hypotheses one through six, because the presence or absence of ability to separate and analyze visual details characteristic of visuald and haptics, respectively, was expected to be related to the visual discrimination required in the tasks used to assess the other cognitive traits. This relationship appears to be supported by the obtained distributions of visuals and haptics in the cognitive style groups.

Discriminant analysis. The discriminant analysis added further support to the postulated relationship between the characteristics of visual and haptic perceptual functioning and the other cognitive style factors examined. It indicates that the performance on four tests for field independence/dependence, re-

reflectivity/impulsivity, and leveling/sharpening could predict perceptual type with significant ($p < .001$) and substantial (88.96%, or 137 cases out of 154) accuracy. It also indicates, because all predictors are significant single discriminators of perceptual type, that the means of the visual and haptic groups on the four cognitive style variables, shown in Table 17, are significantly different.

Table 17

Visual and Haptic Group Means on Cognitive Style Tests

VARIABLE	VISUAL GROUP MEAN	HAPTIC GROUP MEAN
HFT	14.43	4.60
MFF Errors	2.10	5.94
MFF Latency	72.89	55.11
LSHT	12.52	15.90

By using a step-wise discriminant analysis it was possible to determine that visuals are more field independent, reflective, and sharpening than haptics, as indicated by the significantly different mean scores. This supports the results of the chi-square tests. It was also possible to determine not only that performance on the cognitive style tests can predict visual and haptic perceptual type, but also whether each variable can be used as a significant predictor by itself, exactly which variables are the best predictors, and how many variables need be used for optimal prediction in terms of accuracy and parsimony. It was learned from the analysis that HFT, MFF errors, MFF latency, and LSHT are each significant predictors when considered alone, that HFT and errors on MFF are considerably stronger predictors than the other two variables, and that only these two variables need be entered into a prediction system, since the others add no significant contribution.

Another important interpretation allowable from a discriminant analysis in which the prediction system is significant, as in the present case, is that, knowing that individuals fall in given criterion categories, it is possible to make statements about their probable performance on the tests used as predictors in the analysis. From the results of the discriminant analysis, it can be predicted that visual individuals will make higher scores on HFT, fewer errors and longer latencies on MFF, and lower leveling/sharpening ratios on LSHT than haptic individuals. By knowing perceptual type, prediction can be made concerning field independence/dependence, reflectivity/impulsivity, and leveling/sharpening as assessed by the instruments used in this study.

The discriminant analysis revealed that both field independence as measured by HFT and errors on MFF were strong predictors of perceptual type, and thus highly correlated sith it. Latency on MFF and ratio on LSHT were shown to be significant individual predictors, but much less so than the former variables, and therefore less closely related to perceptual type. A greater degree of relationship, or correlation, between perceptual type as measured by SPT-1 and the variables of score on HFT and errors on MFF indicates that a greater degree of the variance in these two variables can be accounted for by variance in the perceptual functioning measured by SPT-1. This idea is further clarified by the results of the factor analysis.

Factor analysis. The factor analysis generated two factors which accounted for 100% of the common variance among the variables of the study. Factor I was characterized by heavy loadings by SPT-1 and HFT, a substantial loading by errors on MFF, and a modest loading by LSHT. Factor II showed heavy loadings by errors on MFF and latency on MFF, and a modest loading by SPT-1.

The measurements which define Factor I have one common element: they all require discrimination of visual details and the ability to either separate them from a field or integrate them into a whole. This suggests the title of Separation and Integration of Visual Details for Factor I. Visual/haptic perceptual type, field independence/dependence in particular and the errors component of reflectivity/impulsivity to a somewhat lesser extent, appear to be definitely related to this factor. Leveling/sharpening also appears to be moderately related to the factor. Thus, at least a part of performance on the pictorial leveling/sharpening task is related to ability to separate and/or integrate visual detail rather than to memory function. However, since the factor loading for leveling/sharpening on Factor I is not great, and is almost zero on Factor II, this suggests that the majority of the variance in the trait is attributable to some factor other than perceptual abilities, presumably the memory function which the dimension purports to define.

Factor II is characterized by strong loadings by errors and latency on MFF and a moderate loading by SPT-1. Since its strongest loadings come from the two measures on the visual task assessing cognitive tempo, the name suggested for the factor is Control of Visual Impulsivity. The modest loading of SPT-1 on this factor indicates that reflectivity/impulsivity is not completely independent of visual/haptic perceptual type. The rather large loading of MFF errors on Factor I as well as Factor II suggests that the relationship between perceptual type and cognitive tempo is more pronounced for the error component of tempo than for the latency component, with latency somewhat independent of perceptual type. It should be remembered that, although error and latency scores on MFF were significant predictors of perceptual type when considered as single predictors on the discirminant analysis, errors were the far more powerful predictor. The chi-square tests and the discriminant analysis did, however, clearly indicate that visuals, as a group, are more reflective than haptics, which takes into account <u>both</u> errors and latency and establishes the following general relationship patterns between perceptual type and the cognitive tempo variables:

<u>visual type:</u> low errors and long latency

<u>haptic type:</u> high errors and short latency

It should be noticed, however, that these patterns concern <u>only</u> those individuals <u>actually classified</u> as impulsive or reflective on MFF; that is, those who scored above median errors and below median latency, or below median errors and above median latency, respectively. An examination of the 39 visuals and haptics who were not classified as either impulsive or reflective shows why errors wer more closely related than latency to perceptual type. Of the 39 unclassified cases, only the eight cases summarized in Table 18 are not relevant to the analysis at hand.

Table 18

Irrelevant Unclassified Cases

CASE NUMBER(S)	PERCEPTUAL TYPE	ERRORS	LATENCY	COMMENTS
1	Haptic	Below Median	Below Median	Typical haptic latency; typical visual errors
2 - 5	Visual	At Median	Above Median	Typical visual latency; borderline errors
6 - 8	Visual	Above Median	Above Median	Typical visual latency; typical haptic errors

None of the cases summarized in Table 18 are instances in which error score is typical of the perceptual type of the individual, but latency score is typical of the opposite perceptual type. The remaining 31 unclassified cases, however, do display such a pattern. These cases are summarized in Table 19.

Table 19

Relevant Unclassified Cases

CASE NUMBERS	PERCEPTUAL TYPE	ERRORS	LATENCY	COMMENTS
1 - 3	Haptic	At Median	Above Median	Borderline errors; typical visual latency
4 - 10	Haptic	Above Median	Above Median	Typical haptic errors; typical visual latency
11 - 16	Visual	At Median	Below Median	Borderline errors; typical haptic latency
17 - 31	Visual	Below Median	Below Median	Typical visual errors; typical haptic latency

The cases summarized in Table 19 show that several haptics, while taking adequate time with the MFF task and thus not classified as impulsive, were unable to perform accurately. These individuals therefore produced error scores typical of haptics (at or above median), but latency scores typical of visuals (above median). Table 18 shows that only three visuals displayed this pattern. A group of visuals, on the other hand, were able to perform the task both very quickly and accurately, thus producing error scores typical of visuals (below median), but latency scores typical of haptics (below median). Table 18 shows that only one haptic displayed this pattern. It is suggested that the unclassified cases with typical error patterns but atypical latency patterns are responsible for the stronger relationship between perceptual type and errors on MFF than between the former variable and latency on MFF.

Major conclusions. The major conclusions of the study are the following:

1. On assessment tasks using visual stimuli, the visual perceptual type tends to display the cognitive style traits of field independence, reflectivity, and sharpening; while the haptic type tends to display field dependence, impulsivity, and leveling.

2. Of the variables used in this study, the best predictors or discriminators of perceptual type are field independence as measured by HFT and errors on MFF.

3. Leveling/sharpening as measured by LSHT contains a major component which is not related to the perceptual functioning measured in this study.

4. Due to patterns in unclassified cases, the error component of cognitive tempo as measured by MFF is more closely related to perceptual type as measured by SPT-1 than is the latency component.

Recommendations for Further Research

The first recommendations for further research concern replication for the present study. It is recommended that the study be replicated to see if similar results occur in other samples so that it can be determined to what extent the results are generalizable. In replicating the discriminant analysis, it is recommended that the variables be forced into the prediction system in the order they were entered in this study. A computer program for discriminant analysis produces the optimal prediction system possible from the data, thus taking advantage of relationships which are perhaps artifactual. Forcing variables to enter the prediction system in a verification study rather than allowing the program to enter them for optimal effect can locate these artifactual relationships.

Another area recommended for further research is the modifiability of an impulsive cognitive tempo through training in scanning visual displays. Attempts at modification through simple delay of response have proven unsuccessful, and the suggestion has been made by Kogan that visual scanning training is necessary for successful modification of high error rates. It would also be worth while to determine if such training, if successful, would transfer to visual tests of field independence and leveling/sharpening since both require similar detail discrimination.

Another recommendation is investigation into the discrepancy discussed previously concerning the contradictory predictions and results obtained on the Witkin tests of field independence from the theoretical viewpoints of Witkin and Lowenfeld. It is possible that the subjects identified as field independent on the BAT and FRT are not using kinesthetic cues as Witkin hypothesizes, or that some analytical ability transcends perceptual type as defined by Lowenfeld.

Another study which would be of merit is an empirical investigation of Kogan's proposed relationship between cognitive tempo and clusters of IQ subtests which are characterized by response uncertainty. This cluster may be the key to the relationship between general IQ and tempo in the same fashion as the embeddedness cluster is the key to the relationship with field independence. This would represent a step in the direction of isolating specific relationships between dimensions of cognitive style and measures of general ability, an issue which is still highly controversial. Studies cited previously indicate a relationship between some dimensions of cognitive style and measures of intelligence, while other research indicates either no relationship or relationship only with certain subsets of intelligence tests. It is suggested that programmatic research be undertaken, possibly in the form of factor analytic studies, which attempt to locate precisely which intelligence tests, or subsets of them, are related to various cognitive style dimensions. If cognitive style is, at least in part, what is being measured with standard intelligence tests, then a portion of the nebulous "general ability" which these tests purport to measure can be defined in a concrete fashion with a sound theoretical base behind it.

A final research recommendation concerns the location of instructional situations in which cognitive styles and perceptual type result in superior or inferior academic performance, and the development of instructional treatments which compensate for, or supplant, perceptual-cognitive problems in these situations. It is possible that, through such research, a body of prescriptive theory can be developed which will allow the accurate prediction of the performance outcomes in learning situations composed of a given type of task, a learner with given perceptual-cognitive styles, and a given instructional modality or method.

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APPENDIX A

ANSWER SHEET FOR SUCCESSIVE PERCEPTION TEST I

NAME____________________________________

Circle the letter of the correct answer. Answer all items.

1. A B C D E
2. A B C D E
3. A B C D E
4. A B C D E
5. A B C D E
6. A B C D E
7. A B C D E
8. A B C D E
9. A B C D E
10. A B C D E
11. A B C D E
12. A B C D E
13. A B C D E
14. A B C D E
15. A B C D E
16. A B C D E
17. A B C D E
18. A B C D E
19. A B C D E
20. A B C D E
21. A B D C E
22. A B C D E
23. A B C D E
24. A B C D E
25. A B C D E
26. A B C D E
27. A B C D E
28. A B C D E
29. A B C D E
30. A B C D E
31. A B C D E
32. A B C D E
33. A B C D E
34. A B C D E
35. A B C D E
36. A B C D E
37. A B C D E
38. A B C D E

APPENDIX B

EXAMINER'S INSTRUCTIONS TO SUBJECT FOR
ADMINISTERING MATCHING FAMILIAR FIGURES

Your job on this task is to find the figure which exactly matches one you are shown. You will be asked to do this 12 times. Speak up as soon as you have located the matching figure and are ready to answer. All you have to say is, "It's this one." Show the examiner which figure you have chosen by pointing to it. You may work as quickly or as slowly as you wish. You may change your answer if you wish, so that you may answer more than once per item if you wish.

When you are ready to see the next item, tell the examiner. Are you ready to being?

APPENDIX C

SCORE SHEET FOR MATCHING FAMILIAR FIGURES

NAME ______________________________

ITEM NUMBER	RESPONSE LATENCY	SECONDS CONVERSION	NUMBER OF ERRORS
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

MEAN RESPONSE LATENCY: __________ SECONDS TOTAL ERRORS: ______

APPENDIX D

EXAMINER'S INSTRUCTIONS TO SUBJECT FOR ADMINISTERING LEVELING-SHARPENING HOUSE TEST

I am going to show you a picture. Look at it for a short time as carefully as you can so that you can remember as much as you can about it. Then I will take it away and show you another picture. When I show you a new picture, look carefully at it and tell me if the picture looks the same or whether anything has changed.

Now look carefully at this picture of a Christmas tree. Try to remember all the picture (SHOW PRACTICE PICTURE 1 FOR 5 SECONDS). Now I will show you another picture of the Christmas tree. Look at it carefully. If this picture is different from the first one, say STOP and then tell me what is different from the first one. If there is nothing different, you don't have to say anything. (SHOW PRACTICE PICTURE 2 FOR 5 SECONDS)

Let's continue for several pictures for practice. Remember to say STOP any time you see that any picture is different from that first picture you saw. Then tell me what is different in the picture. You need not report a change more than once. Do you have any questions? (SHOW PRACTICE PICTURES 3 through 6 for 5 SECONDS EACH)

Do you have any questions? (ANSWER ALLOWABLE QUESTIONS)

We'll begin the real pictures. I'll show you these pictures one at a time for a short time. Look at the picture as carefully as you can as long as it is in front of you. After you see the first picture, if any of the other pictures look different or something looks like it has changed, say STOP.

Then tell me what has changed. If the picture looks the same, you don't have to say anything. Remember, sometimes the pictures will look the same, and sometimes they will look different. Are you ready to begin?

APPENDIX E

SUBJECT NUMBER	SPT-1					HFT		MFF			LSHT	
	Items Correct	Items Incorrect	% Correct	% Incorrect	V/H/IND.	Score	FD/FI/IND.	Errors	Mean Latency	IMP/REF/IND.	L/S RATIO	L/S/IND.
1	23	12	66	34	V	8	IND	1	70.41	R	13.16	IND
2	22	13	63	37	V	17	FI	0	77.00	R	11.05	S
3	21	14	60	40	V	4	FD	2	61.83	IND	10.53	S
4	13	22	37	63	H	4.50	FD	5	61.16	I	19.00	L
5	23	12	66	34	V	11	IND	1	65.58	R	10.95	S
6	21	14	60	40	V	5	FD	2	62.33	IND	9.95	S
7	24	11	69	31	V	13	FI	7	58.08	I	9.37	S
8	21	14	60	40	V	10	IND	2	130.50	R	6.89	S
9	9	26	26	74	H	- 1	FD	8	45.25	I	15.84	L
10	26	9	74	26	V	1.25	FD	5	56.00	I	10.68	S
11	29	6	83	17	V	19	FI	1	84.66	R	10.63	S
12	19	16	54	46	IND	8.75	IND	3	76.83	IND	8.00	S
13	26	9	74	26	V	17	FI	1	66.33	R	9.00	S
14	22	13	63	37	V	15	FI	2	33.75	IND	8.84	S
15	28	7	80	20	V	13	FI	0	81.00	R	10.05	S
16	23	12	66	34	V	15	FI	3	78.42	IND	10.05	S
17	17	18	48	52	IND	5.75	FD	3	69.33	IND	11.00	S
18	19	16	54	46	IND	12.50	IND	10	31.00	I	14.00	IND
19	28	7	80	20	V	17	FI	8	9.08	I	11.26	S

SUBJECT NUMBER	SPT-1 Items Correct	Items Incorrect	% Correct	% Incorrect	V/H/IND.	HFT Score	FD/FI/IND.	MFF Errors	Mean Latency	IMP/REF/IND.	LSHT L/S RATIO	L/S/IND.
20	22	13	63	37	V	18	FI	2	67.33	R	8.16	S
21	25	10	72	28	V	11	IND	1	98.83	R	11.11	S
22	13	22	37	63	H	3	FD	2	126.66	R	14.16	IND
23	10	25	29	71	H	6.5	IND	11	31.08	I	18.21	L
24	21	14	60	40	V	11	IND	2	68.16	R	10.89	S
25	22	13	63	37	V	14	FI	2	69.91	R	10.53	S
26	23	12	66	34	V	20	FI	1	86.58	R	8.84	S
27	20	15	57	43	IND	5.75	FD	1	90.50	R	9.84	S
28	17	18	48	52	IND	13	FI	9	33.08	I	16.21	L
29	21	14	60	40	V	6	FD	3	57.41	IND	8.68	S
30	9	26	26	74	H	20	FI	6	32.91	I	11.16	S
31	22	13	63	37	V	13	FI	2	62.83	IND	14.37	IND
32	18	17	52	48	IND	8.50	IND	8	33.66	I	13.63	IND
33	25	10	72	28	V	13.50	FI	0	126.50	R	13.58	IND
34	10	25	29	71	H	4.75	FD	7	44.00	I	18.84	L
35	10	25	29	71	H	-2	FD	9	16.91	I	18.53	L
36	21	14	60	40	V	13	FI	1	47.50	IND	7.84	S
37	11	24	32	68	H	19	FI	4	75.16	IND	16.21	L
38	19	16	54	46	IND	6	FD	10	38.41	I	7.53	S

	SPT-1					HFT		MFF			LSHT	
SUBJECT NUMBER	Items Correct	Items Incorrect	% Correct	% Incorrect	V/H/IND.	Score	FD/FI/IND.	Errors	Mean Latency	IMP/REF/IND.	L/S RATIO	L/S/IND.
39	8	27	23	77	H	6	FD	9	47.08	I	16.26	L
40	28	7	80	20	V	13	FI	3	67.50	IND	17.63	L
41	11	24	32	68	H	6	FD	6	49.58	I	12.74	IND
42	14	21	40	60	H	1	FD	5	84.75	IND	19.32	L
43	12	23	34	66	H	6.75	IND	4	61.25	I	14.26	IND
44	11	24	31	69	H	.75	FD	8	28.58	I	16.05	L
45	21	14	60	40	V	12.50	IND	1	103.92	R	17.89	L
46	16	19	46	54	IND	6	FD	1	89.67	R	9.89	S
47	21	14	60	40	V	-.50	FD	0	129.25	R	8.00	S
48	21	14	60	40	V	10	IND	2	76.32	R	10.24	S
49	10	25	29	71	H	2.50	FD	9	44.00	I	14.11	IND
50	18	17	52	48	IND	5.75	FD	0	102.50	R	14.11	IND
51	8	27	23	77	H	1.50	FD	12	7.67	I	16.89	L
52	23	12	66	34	V	11	IND	4	64.50	I	13.68	IND
53	24	11	69	31	V	16	FI	0	132.00	R	7.95	S
54	24	11	69	31	V	16.75	FI	2	58.83	IND	6.16	S
55	20	15	57	43	IND	1	FD	6	23.92	I	14.00	IND
56	21	14	60	40	V	10	IND	1	83.91	R	10.45	S
57	21	14	60	40	V	19	FI	3	73.58	IND	11.37	S

	SPT-1					HFT		MFF			LSHT	
SUBJECT NUMBER	Items Correct	Items Incorrect	% Correct	% Incorrect	V/H/IND.	Score	FD/FI/IND.	Errors	Mean Latency	IMP/REF/IND.	L/S RATIO	L/S/IND.
58	15	20	43	57	IND	16	FI	6	38.50	I	11.53	IND
59	13	22	37	63	H	0	FD	5	91.58	IND	11.37	S
60	11	24	31	69	H	2.5	FD	7	55.75	I	17.95	L
61	11	24	31	69	H	5.75	FD	5	48.92	I	12.47	IND
62	18	17	52	48	IND	7	IND	9	37.25	I	7.84	S
63	25	10	71	29	V	18	FI	2	58.00	IND	10.79	S
64	19	16	54	46	IND	1	FD	2	48.83	IND	14.63	IND
65	11	24	31	69	H	11	IND	4	73.83	IND	14.32	IND
66	26	9	74	26	V	11	IND	6	40.17	I	8.79	S
67	10	25	29	71	H	3.75	FD	4	73.17	IND	11.63	IND
68	18	17	52	48	IND	8	IND	3	61.72	INS	13.48	IND
69	21	14	60	40	V	15	FI	4	60.08	I	14.79	L
70	12	23	34	66	H	5.25	FD	10	18.58	I	14.21	IND
71	13	22	37	63	H	4	FD	5	72.83	IND	15.05	L
72	24	11	69	31	V	18	FI	1	73.41	R	10.36	S
73	10	25	29	71	H	2.25	FD	1	104.92	R	16.68	L
74	22	13	63	37	V	21	FI	1	87.25	R	12.00	IND
75	24	11	69	31	V	16.75	FI	2	67.83	R	16.05	L
76	16	19	46	54	IND	16.75	FI	15	47.75	I	17.84	L

	SPT-1					HFT		MFF			LSHT	
SUBJECT NUMBER	Items Correct	Items Incorrect	% Correct	% Incorrect	V/H/IND.	Score	FD/FI/IND.	Errors	Mean Latency	IMP/REF/IND.	L/S RATIO	L/S/IND.
77	12	23	34	66	H	2.75	FD	7	40.81	I	17.01	L
78	16	19	46	54	IND	9.75	IND	6	36.42	I	15.58	L
79	22	13	63	37	V	5.75	FD	3	53.25	IND	13.53	IND
80	17	18	48	52	IND	12	IND	2	70.31	R	13.48	IND
81	21	14	60	40	V	13.75	FI	4	95.92	IND	18.42	L
82	20	15	57	43	IND	3	FD	8	58.08	I	8.63	S
83	14	21	40	60	H	8	IND	3	65.13	IND	14.71	L
84	13	22	37	63	H	1.75	FD	6	39.55	I	17.92	L
85	14	21	40	60	H	1.75	FD	2	59.92	IND	9.89	S
86	30	5	86	14	V	16	FI	1	61.00	IND	10.11	S
87	12	23	34	66	H	14	FI	1	68.81	R	16.74	L
88	17	18	48	52	IND	10	IND	9	27.25	I	13.21	IND
89	24	11	69	31	V	18.50	FI	8	37.50	I	13.42	IND
90	21	14	60	40	V	14	FI	2	69.50	R	17.74	L
91	19	16	54	46	IND	8	IND	3	66.42	IND	11.42	S
92	14	21	40	60	H	4.75	FD	10	44.42	I	15.26	L
93	18	17	52	48	IND	10.75	IND	1	82.75	R	16.05	L
94	24	11	69	31	V	14	FI	3	59.75	IND	9.42	S
95	19	16	54	46	IND	1.75	FD	3	63.84	IND	17.46	L

SUBJECT NUMBER	SPT-1 Items Correct	SPT-1 Items Incorrect	SPT-1 % Correct	SPT-1 % Incorrect	SPT-1 V/H/IND.	HFT Score	HFT FD/FI/IND.	MFF Errors	MFF Mean Latency	MFF IMP/REF/IND.	LSHT L/S RATIO	LSHT L/S/IND.
96	16	19	46	54	IND	10.75	IND	11	47.00	I	18.37	L
97	22	13	63	37	V	15	FI	0	78.10	R	11.25	S
98	29	6	83	17	V	18	FI	3	72.50	IND	13.16	IND
99	14	21	40	60	H	2.50	FD	5	55.92	I	16.58	L
100	13	22	37	63	H	2	FD	4	60.18	I	17.77	L
101	18	17	52	48	IND	1.75	FD	6	49.93	I	16.84	L
102	14	21	40	60	H	2.75	FD	5	44.67	I	15.26	L
103	21	14	60	40	V	23	FI	0	50.28	IND	9.47	S
104	19	16	54	46	IND	11.75	IND	2	74.92	R	16.47	L
105	21	14	60	40	V	10	IND	2	50.83	IND	13.89	IND
106	23	12	66	34	V	21	FI	0	65.25	R	9.53	S
107	27	8	77	23	V	17	FI	2	64.83	R	11.42	S
108	14	21	40	60	H	.50	FD	5	56.42	I	16.32	L
109	21	14	60	40	V	27	FI	6	43.42	I	13.74	IND
110	17	18	48	52	IND	3.50	FD	2	60.00	IND	9.05	S
111	17	18	48	52	IND	13	FI	1	71.05	R	13.41	IND
112	17	18	48	52	IND	8.50	IND	5	47.75	I	18.79	L
113	21	14	60	40	V	8	IND	1	92.67	R	10.63	S
114	25	10	71	29	V	12	IND	1	71.58	R	15.53	L

	SPT-1					HFT		MFF			LSHT	
SUBJECT NUMBER	Items Correct	Items Incorrect	% Correct	% Incorrect	V/H/IND.	Score	FD/FI/IND.	Errors	Mean Latency	IMP/REF/IND.	L/S RATIO	L/S/IND.
115	14	21	40	60	H	13.25	FI	7	58.25	I	15.42	L
116	21	14	60	40	V	20	FI	1	85.17	R	13.37	IND
117	12	23	34	66	H	1.25	FD	6	19.75	I	15.11	L
118	21	14	60	40	V	9	IND	4	76.17	IND	12.68	IND
119	21	14	60	40	V	22.50	FI	3	40.83	IND	12.89	IND
120	23	12	66	34	V	14.75	FI	3	51.83	IND	9.21	S
121	18	17	52	48	IND	11.75	IND	3	51.67	IND	9.79	S
122	19	16	54	46	IND	3.50	FD	1	65.33	R	11.47	L
123	10	25	29	71	H	0	FD	8	28.32	I	18.29	L
124	25	10	71	29	V	11	IND	2	61.50	IND	15.47	L
125	21	14	60	40	V	13	FI	6	56.75	I	11.89	IND
126	14	21	40	60	H	3.50	FD	1	119.50	R	14.05	IND
127	19	16	54	46	IND	5	FD	2	75.81	R	16.45	L
128	22	13	63	37	V	23.25	FI	0	90.83	R	10.58	S
129	23	12	66	34	V	23	FI	0	80.25	R	10.79	S
130	21	14	60	40	V	20	FI	2	65.42	R	11.63	IND
131	24	11	69	31	V	14	FI	6	39.33	I	12.05	IND
132	21	14	60	40	V	20	FI	1	74.50	R	11.21	S
133	22	13	63	37	V	25	FI	2	61.83	IND	12.74	INS

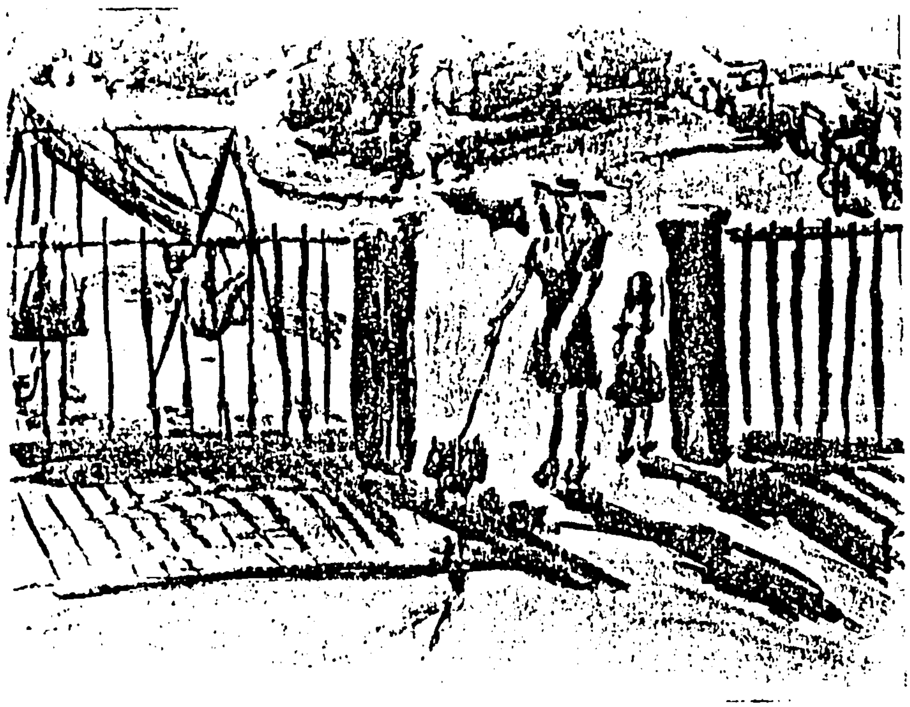
	SPT-1					HFT		MFF			LSHT	
SUBJECT NUMBER	Items Correct	Items Incorrect	% Correct	% Incorrect	V/H/IND.	Score	FD/FI/IND.	Errors	Mean Latency	IMP/REF/IND.	L/S RATIO	L/S/IND.
134	18	17	52	48	IND	5	FD	12	30.00	I	11.63	IND
135	21	14	60	40	V	13.50	FI	3	31.67	IND	16.32	L
136	9	26	26	74	H	13.75	FI	4	63.33	I	19.00	L
137	23	12	66	34	V	17	FI	1	108.08	R	9.53	S
138	12	23	34	66	H	-1	FD	8	41.48	I	17.29	L
139	17	18	48	52	IND	11.50	IND	5	94.42	IND	13.53	IND
140	22	13	63	37	V	24	FI	2	35.00	IND	13.84	IND
141	20	15	57	43	IND	7.75	IND	3	65.76	IND	15.37	L
142	14	21	40	60	H	7	IND	6	21.38	I	17.41	L
143	21	14	60	40	V	9	IND	5	52.37	I	13.25	IND
144	26	9	74	26	V	9	IND	0	78.46	R	12.51	IND
145	22	13	63	37	V	13.75	FI	1	73.37	R	12.18	IND
146	14	21	40	60	H	4.5	FD	7	28.25	I	17.94	L
147	21	14	60	40	V	22.75	FI	0	81.58	R	9.05	S
148	19	16	54	46	IND	6	FD	8	33.37	I	13.18	IND
149	25	10	71	29	V	22	FI	0	66.76	R	8.65	S
150	24	11	69	31	V	15	FI	2	71.19	R	10.71	S
151	13	22	37	63	H	2.50	FD	1	117.25	R	14.53	IND
152	23	12	66	34	V	6	FD	0	81.67	R	8.79	S

	SPT-1					HFT		MFF			LSHT	
SUBJECT NUMBER	Items Correct	Items Incorrect	% Correct	% Incorrect	V/H/IND.	Score	FD/FI/IND.	Errors	Mean Latency	IMP/REF/IND.	L/S RATIO	L/S/IND.
153	21	14	60	40	V	17.75	FI	2	60.33	IND	10.32	S
154	10	25	29	71	H	.75	FD	9	29.81	I	18.05	L
155	21	14	60	40	V	13	FI	1	83.49	R	11.63	IND
156	23	12	66	34	V	18	FI	4	55.33	I	13.32	IND
157	12	23	34	66	H	11	IND	3	78.83	IND	16.51	L
158	16	19	46	54	IND	6.50	IND	5	106.58	IND	14.68	L
159	27	8	77	23	V	13	FI	2	72.75	R	13.16	IND
160	12	23	34	66	H	6	FD	5	84.50	IND	14.37	IND
161	18	17	52	48	IND	11	IND	7	46.42	I	16.78	L
162	23	12	66	34	V	20	FI	0	92.01	R	8.80	S
163	29	9	74	26	V	27	FI	1	53.00	IND	12.16	IND
164	18	17	52	48	IND	8	IND	3	76.25	IND	11.89	IND
165	20	15	57	43	IND	6.75	IND	3	81.83	IND	13.42	IND
166	30	5	86	14	V	16	FI	0	73.33	R	13.05	IND
167	21	14	60	40	V	6	FD	0	77.50	R	12.89	IND
168	19	16	54	46	IND	0	FD	7	64.83	IND	14.53	IND
169	18	17	52	48	IND	9.75	IND	1	84.17	R	8.63	S
170	25	10	71	29	V	19	FI	0	71.36	R	9.47	S
171	14	21	40	60	H	9	IND	5	54.58	I	14.00	IND

SUBJECT NUMBER	SPT-1 Items Correct	SPT-1 Items Incorrect	SPT-1 % Correct	SPT-1 % Incorrect	SPT-1 V/H/IND.	HFT Score	HFT FD/FI/IND.	MFF Errors	MFF Mean Latency	MFF IMP/REF/IND.	LSHT L/S RATIO	LSHT L/S/IND.
172	21	14	60	40	V	8	IND	0	70.92	R	11.37	S
173	17	18	48	52	IND	5.25	FD	5	65.57	IND	14.81	L
174	29	6	83	17	V	14	FI	0	71.00	R	8.32	S
175	17	18	48	52	IND	11	IND	2	88.84	R	13.21	IND
176	12	23	34	66	H	3.75	FD	8	32.64	I	17.63	L
177	22	13	63	37	V	17	FI	1	84.17	R	13.37	IND
178	10	25	29	71	H	2	FD	2	140.58	R	12.21	IND
179	26	9	74	26	V	11	IND	1	71.00	R	13.68	IND
180	23	12	66	34	V	12	IND	4	89.67	IND	13.16	IND
181	24	11	69	31	V	17.25	FI	3	69.50	IND	11.47	S
182	14	21	40	60	H	2	FD	3	73.08	IND	14.58	IND
183	9	26	26	74	H	.75	FD	11	13.75	I	18.74	L
184	14	21	40	60	H	-1.25	FD	9	20.25	I	23.26	L
185	17	18	48	52	IND	9	IND	6	42.67	I	14.84	L
186	16	19	46	54	IND	2.50	FD	10	50.06	I	15.67	L
187	21	14	60	40	V	11.50	IND	7	14.17	I	16.42	L
188	16	19	46	54	IND	.25	FD	2	71.15	R	14.48	IND
189	20	15	57	43	IND	1.25	FD	6	48.15	I	11.81	IND
190	21	14	60	40	V	16	FI	7	47.42	I	13.37	IND

	SPT-1					HFT		MFF			LSHT	
SUBJECT NUMBER	Items Correct	Items Incorrect	% Correct	% Incorrect	V/H/IND.	Score	FD/FI/IND.	Errors	Mean Latency	IMP/REF/IND.	L/S RATIO	L/S/IND.
191	21	14	60	40	V	14.75	FI	1	77.71	R	11.37	S
192	18	17	52	48	IND	2.25	FD	3	81.29	IND	16.63	L
193	13	22	37	63	H	1.75	FD	8	25.42	I	17.63	L
194	21	14	60	40	V	10	IND	3	66.93	IND	13.66	IND
195	14	21	40	60	H	5.75	FD	7	57.14	I	15.77	L
196	27	8	77	23	V	13	FI	0	79.15	R	8.21	S
197	21	14	60	40	V	25.75	FI	6	57.00	I	11.00	S
198	16	19	46	54	IND	11	IND	1	101.58	R	17.11	L
199	7	28	20	80	H	.50	FD	9	64.33	I	14.58	IND
200	24	11	69	31	V	18	FI	2	110.17	R	17.16	L
201	18	17	52	48	IND	11	IND	1	74.83	R	16.47	L
202	24	11	69	31	V	11	IND	1	102.58	R	12.74	IND
203	20	15	57	43	IND	5.75	FD	4	48.82	I	15.12	L
204	14	21	40	60	H	12	IND	6	27.25	I	15.63	L
205	18	17	52	48	IND	4	FD	1	89.13	R	16.37	L
206	21	14	60	40	V	9	IND	6	46.17	I	14.26	IND

APPENDIX F



Painting A: "Street Scene", painted by a visual adolescent, age 16.

Painting B. "Lying on the Bed," painted by a haptic adolescent, age 17.

Figure 2. Visual (A) and Haptic (B) Paintings.
(Lowenfeld, 1957, pp. 274-275)

Drawing A. "A Scene at the Police Station," drawn by a visual adolescent.

Drawing B. "A Scene at the Police Station," drawn by a haptic adolescent.

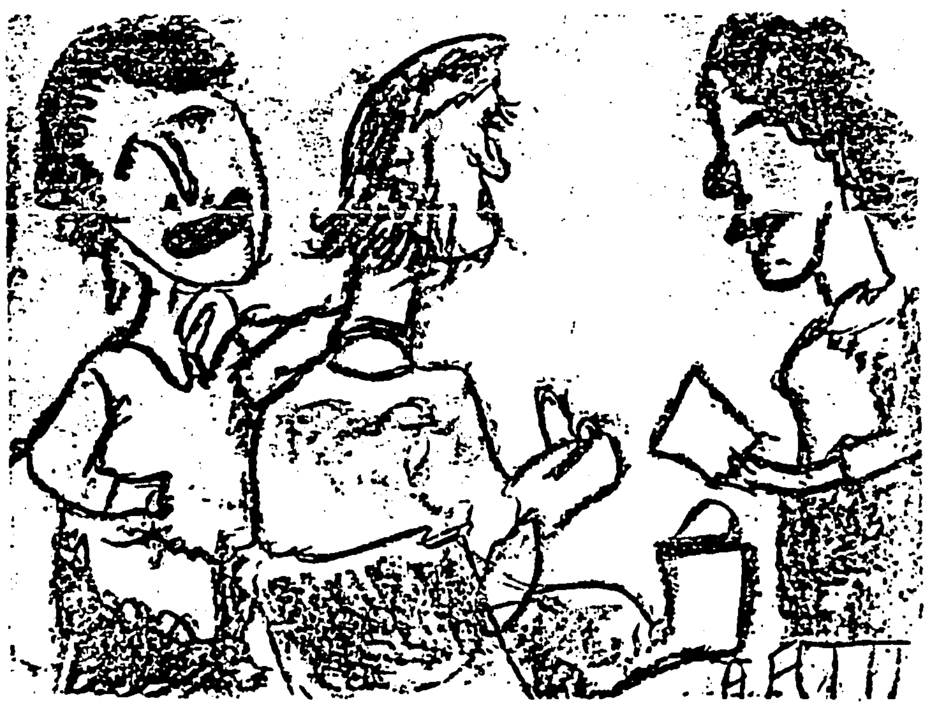


Figure 3. Visual (A) and Haptic (B) Drawings. (Lowenfeld & Brittain, 1970, p. 241)

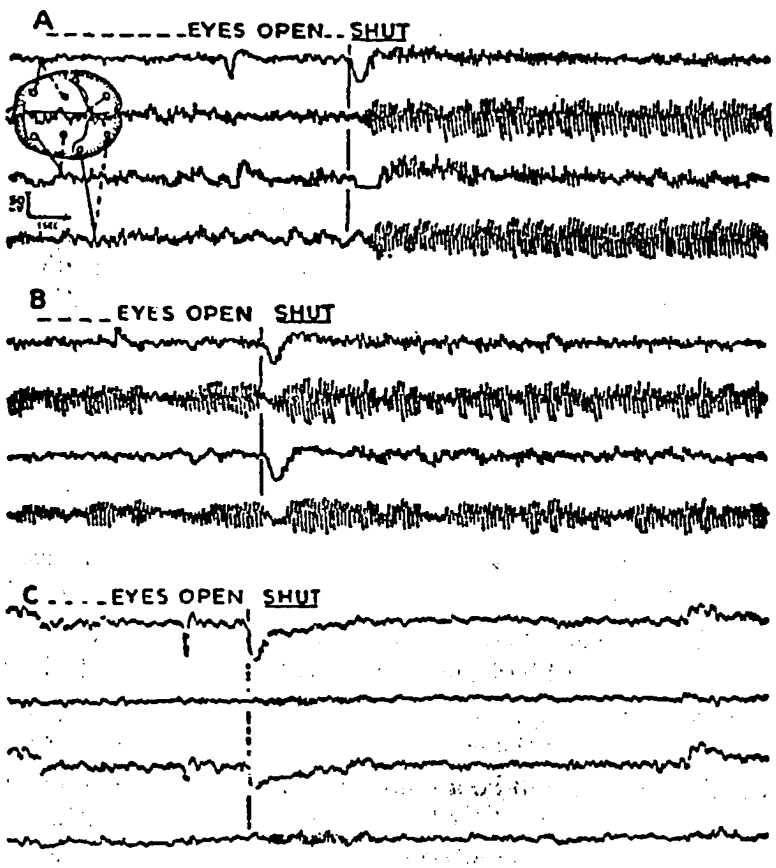


Figure 4. Alpha rhythm patterns of (A) R type, (B) P type, and (C) M type individuals. (Walter, 1963, p. 215)